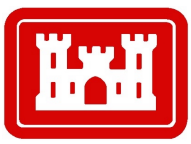
CENTRAL AND SOUTHERN FLORIDA PROJECT
MODIFIED WATER DELIVERIES TO
EVERGLADES NATIONAL PARK, FLORIDA

8.5 SQUARE MILE AREA

GENERAL REEVALUATION REPORT

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

JULY 2000



HDR Engineering, Inc.

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SECTION 1.0
INTRODUCTION

1.1 PROJECT DESCRIPTION

The 8.5 Square Mile Area (8.5 SMA) is an inhabited area bounded on the west by the Everglades National Park (ENP), and separated from more intensively developed urban lands to the east by the L-31N flood protection levee and borrow canal. In 1992, a flood mitigation plan was authorized for the 8.5 SMA as part of the Modified Water Deliveries to ENP Project (MWD Project). This plan included the construction of a protective levee and seepage canal around the 8.5 SMA that would mitigate for higher stages associated with implementing the MWD Project. Since 1992, several of the other features of the MWD Project have been constructed; however, the full implementation of the MWD Project cannot occur until flood mitigation is provided to the 8.5 SMA.

The flood mitigation plan for the 8.5 SMA has been the subject of much study and debate since the authorization of the MWD Project. Several studies have developed and evaluated new alternatives, and reevaluated the potential impacts of previously proposed alternatives. In July 1999, the South Florida Water Management District (SFWMD), the local sponsor for this project, requested that the United States Army Corps of Engineers (USACE) formally develop and evaluate a full array of alternatives for providing flood mitigation to the 8.5 SMA.

The USACE prepared this planning document to assist in the selection of a Recommended Plan for providing flood mitigation to the 8.5 SMA while allowing for restoration of the Northeast Shark River Slough (NESRS) as authorized by the MWD Project. This planning document includes a General Reevaluation Report (GRR) and a Final Supplemental Environmental Impact Statement (FSEIS). Together, these documents present information regarding the engineering features, expected performance, and potential impacts of various alternatives. This document has been used as the basis for selecting a Recommended Plan for the 8.5 SMA component of the MWD Project.

1.2 PROJECT HISTORY

1.2.1 The Central and Southern Florida Flood Control Project

The historic Everglades was originally a broad, shallow wetland flowing imperceptibly from Lake Okeechobee to the mangrove zone at the southern tip of Florida. In an effort to control flooding and better manage water in South Florida, a complex system of canals, levees, structures, pumps, and impoundments known as the Central and Southern Florida Flood Control Project (C&SF) was constructed. Congress initially authorized this project in 1948 and provided

additional authorization in subsequent years. Figure 1 depicts the features of the C&SF project.

Following construction of Water Conservation Areas (WCA) 3A and 3B and the southward extension of Levee 67 (L-67 ext) in the early 1960's, the natural flows to ENP at the southern terminus of the project became subject to control and dictated by an established regulation schedule. Discharges were sporadic and based on needs to retain water for urban and agricultural use during the dry season, and to maintain flood control capacity in the urban and agricultural areas during the wet season. As a result of severe impacts to ENP from droughts in the mid-1960's, Congress established a minimum water delivery schedule to protect ENP resources (PL 91-282 (June 1970)). This minimum delivery schedule remained intact for much of the 1970's.

The Flood Control Act of 1968 (PL 90-483) authorized the implementation of the Everglades National Park-South Dade Conveyance System (ENP-SDCS). The Act provided for modifications to the existing C&SF Project for the purposes of improving the supply and distribution of water supplies to ENP, and for meeting expanded agricultural and urban water needs in Dade County. The construction of the system included modifications to the original levee and borrow canal L-31 (currently comprised of L-31N and L-31W) and construction of control structure S-331.

1.2.2 Experimental Program of Water Deliveries

The Experimental Program of Water Deliveries to ENP (*PL 98-181, Section 1302: Supplemental Appropriations Act of 1984, 30 November 1984*) authorized the modification of the Minimum Delivery Schedule (PL 91-282). This program allowed for a two-year Experimental Program of Water Deliveries to ENP for the purposes of developing an improved regulation/delivery schedule. The law also authorized the Secretary of the Army to acquire agricultural lands and construct necessary flood protection measures for the protection of homes affected by the modification of the delivery schedule (i.e., the 8.5 SMA).

In response to PL 98-181, the USACE completed the *General Plan for Implementation of an Improved Water Delivery Schedule to Everglades National Park, Florida* in January 1985, which was approved by the Secretary of the Army on February 28, 1985. This plan recommended: (1) the preparation of a General Design Memorandum (GDM) and an Environmental Impact Statement (EIS) addressing modifications to improve water deliveries to ENP, and (2) extension of the two-year time limit specified in PL 98-181 based on a written agreement between USACE, ENP, and SFWMD. The Experimental Program of Water Deliveries was subsequently extended to January 1, 1989 and January 1, 1992 under PL 99-190 and PL 100-676, respectively.

1.2.3 Modified Water Deliveries to Everglades National Park Project

The Everglades National Park Protection and Expansion Act of 1989 (PL 101-229 Section 104) authorized the Secretary of the Army to construct modifications to the C&SF Project to improve water deliveries to ENP. Alternatives to restore natural hydrologic conditions in the park were evaluated in a GDM (Modified Water Deliveries to Everglades National Park, 1992) and EIS. Specifically, this 1992 GDM addressed the water deliveries through the NESRS portion of the C&SF Project. Figure 2 depicts the features of the MWD Project.

The Authorized Plan as presented in the GDM included a flood mitigation system for the 8.5 SMA in the East Everglades. Implementation of the MWD Project, as outlined in the GDM, would result in an increase in water flows through NESRS that would raise ground water levels and increase the current spatial extent and frequency of flooding in the 8.5 SMA. The flood mitigation system would prevent the 8.5 SMA from experiencing any increase in flooding as a result of the MWD Project.

The flood mitigation system authorized by the GDM consisted of a protection levee, a seepage canal, and an interior berm. These features would surround the area to the north and west and tie into L-31N. Seepage water would be collected in the seepage canal, located between the exterior levee and interior berm, and conveyed to a pump station on the northeast corner of the project area. This seepage pump station would transfer water into the L-31N canal for conveyance north. See Section 3.4.1 for a full description of the Authorized Plan. Figure 4 depicts the specific features of the authorized 8.5 SMA flood mitigation system.

1.3 PROJECT NEED OR OPPORTUNITY

In June 1992, the GDM for the MWD Project was approved by the Chief of the Engineering Division, Directorate of Civil Works, USACE. This approval fulfilled the requirements of Section 104 of the 1989 Everglades National Park Protection and Expansion Act (PL 010-229), which directed the Secretary of the Army to select the plan that accomplished the goals of the MWD Project to the extent practicable. A Record of Decision (ROD) was executed by the USACE on May 13, 1993. The general goal of the MWD Project was to increase the quantity and improve the timing of water delivered from the C&SF System to ENP. The specific directive relative to the 8.5 SMA was to build a flood mitigation project for the residential areas in the East Everglades that were going to be adversely affected by the increasing water deliveries due to the MWD Project.

Following project authorization in 1992, there have been several studies of the 8.5 SMA flood mitigation component. Expanded scientific ecosystem restoration

knowledge and significant improvements to hydrologic modeling capabilities have enhanced our understanding of the restoration requirements of the Everglades ecosystem. The need to integrate the MWD Project with the C-111 Project, which has been designed and partially implemented, and the Comprehensive Everglades Restoration Plan (CERP) became evident. The SFWMD, ENP, and others suggested additional potential options that would meet the legislated mitigation requirements and other interests in the 8.5 SMA while ensuring environmental restoration of NESRS. Consequently, the SFWMD, ENP, and others have suggested the flood mitigation system approved by the USACE in 1992 may no longer represent the best alternative for attaining full restoration of NESRS while simultaneously meeting the need for a flood mitigation system in the 8.5 SMA.

The SFWMD, as the local sponsor, has reviewed the subsequent analysis of the cost of construction, operation, and maintenance of the authorized flood mitigation components, along with new information and technologies. This evaluation prompted the SFWMD Governing Board to request that the USACE evaluate additional alternatives with respect to the 8.5 SMA. Various alternatives were developed for consideration, with a goal of ensuring the natural hydrology of the NESRS would be restored while meeting the needs of the landowners of the 8.5 SMA.

This GRR/SEIS presents hydrologic modeling simulations, social impact assessments, policy analysis, real estate information, engineering design and cost analysis, environmental impact assessment, economics calculations and review of public concerns. The USACE and the Department of Interior (DOI) will use this as a decision document for potential future Federal action on this project. In addition, the SFWMD Governing Board has based its recommendation on this information.

SECTION 2.0
AUTHORIZED PROJECT

2.1 PROJECT AUTHORITY

Everglades National Park Protection and Expansion Act, (PL101-229, Section 104, December 1989). The Everglades National Park Protection and Expansion Act, authorized the Secretary of the Army, upon completion of a GDM, to modify the C&SF project to improve water deliveries to ENP and to take steps to restore ENP natural hydrological conditions. These modifications were specified in a GDM completed by the USACE in 1992 entitled *Modified Water Deliveries to Everglades National Park.* In June 1992, the MWD GDM was approved by the Chief of the Engineering Division, Directorate of Civil Works, USACE. This approval fulfilled the requirements of Section 104 of the 1989 Everglades National Park Protection and Expansion Act, which directed the Secretary of the Army to select the plan that accomplished the goals of MWD to the extent practicable.

In regards to flood protection for the 8.5 SMA, the Act states: "If the Secretary of the Army makes a determination pursuant to subsection (b) that the Eight and One-Half Square Mile Area will be adversely affected, the Secretary of the Army is authorized and directed to construct a flood protection system for that portion of presently developed land within such area."

Although the Act states "flood protection", it is clear that such protection is to be limited to that which would be necessary to protect against impacts as a result of implementation of the MWD Project. To alleviate the potential adverse effects on the 8.5 SMA due to implementation of the MWD Project, a number of alternatives were analyzed during the development of the 1992 GDM. Since the intent was to provide protection against impacts caused by the project and not to provide complete flood protection, use of the term "mitigation" versus "protection" was adopted by the USACE in the 1992 GDM.

A component of the Authorized Plan in the GDM included the construction of a flood mitigation system for the 8.5 SMA consisting of a levee, berm and seepage collection system surrounding the area to the north and west which ties into L-31N. The seepage collection canal conveys seepage water to a pump station on the northeast corner and discharges to L-31N Borrow canal.

The USACE and the SFWMD executed a Project Cooperation Agreement (PCA), dated September 29, 1994, for implementation of the MWD Project as described in the 1992 GDM.

Interagency Agreement Between the Department of the Interior, National Park Service, and the Department of the Army (Interagency Agreement No. IA-5000-1-9501, June 1991). This agreement was entered into for the purpose of implementing the provisions of the Everglades National Park Protection and Expansion Act of 1989, with specific reference to modifications of the C&SF Project to improve water deliveries to ENP. This agreement specified that the National Park Service (NPS) shall make available to the USACE such funds as are appropriated for the USACE's activities authorized under Section 104 of the 1989 Act. As such, DOI, through the NPS, is funding 100% of the initial cost of the authorized project, and the USACE is funding 75% of the operation and maintenance cost. This agreement is the current mechanism used by the DOI to transfer funds to the USACE for implementation of the project features associated with the MWD Project.

Everglades National Park Protection and Expansion Act of 1989, Amendment (PL 103-219, 9 March 1994). This act amended the original act (PL 101-229) by adding an additional section pertaining to land acquisition. The amendment allows for the Secretary of the Interior to provide up to 25% of the funding for land acquisition in the Frog Pond, Rocky Glades Agricultural Area, and 8.5 SMA.

2.2 DESCRIPTION OF STUDY AREA

The 1992 GDM for MWD dealt with a project area that included the ENP, East Everglades, and WCA 3. That area is located in Broward and Miami-Dade Counties, west and southwest of the Ft. Lauderdale - Miami metropolitan area and is fully described in the GDM.

The focus of this current study is on the 8.5 SMA component of the MWD Project. Its name notwithstanding, the 8.5 SMA presently encompasses approximately 10 square miles of mixed use development. Also known as the East Everglades Agricultural and Residential Area, the 8.5 SMA is located in the East Everglades, approximately 20 miles southwest of Miami, approximately 10 miles north of Homestead, and 6.6 miles south of U.S. Highway 41 (Figure 3). It is bounded on the east by L-31N, on the west by ENP, on the north by SW 104th Street, and on the south by SW 168th Street (Richmond Drive).

However, for the purposes of this reevaluation, the area that has been studied (hereafter called the "study area") encompasses any area where impacts from this project may occur. Therefore, the 8.5 SMA study area is bounded roughly on the west and north by NESRS, on the south by the Taylor Slough headwaters and on the east by the urban and agricultural areas east of L-31N. Figure 3 shows the location of the 8.5 SMA and the general features of the area of potential effects.

The following sections contain a general description of resources, features, problems and needs relative to the study area. More detailed information about these and other issues is included in later sections of this report and in the SEIS.

2.2.1 Geographic/Watershed Features

Geographically, the 8.5 SMA lies within a region commonly referred to as the Rocky Glades, occupying the western slope of the Atlantic Coastal Ridge (Figure 3). The Rocky Glades forms a narrow transitional area between the Shark River Slough and Taylor Slough Headwaters physiographic zones. It also comprises a significant topographical, geological, hydrological, and ecological transition between the Atlantic Coastal Ridge proper and the Everglades trough. Topographic elevations range from 5.0 to 8.5-ft. National Geodetic Vertical Datum (NGVD) with the higher elevations (above 7.0-ft.) generally in the east and southeast portions of the 8.5 SMA.

The geology of the area is characterized by the highly transmissive, water bearing, unconfined limestone Biscayne Aquifer. The aquifer extends from the Broward-Palm Beach County boundary southward through Miami-Dade County. It is the sole source of potable water in Miami-Dade and Broward Counties and one of the most permeable aquifers in the world. The U.S. Environmental Protection Agency (USEPA) has designated the Biscayne Aquifer as a “sole source” aquifer under the provisions of the Safe Drinking Water Act (SDWA) of 1974. The aquifer is exposed at the surface in most of the area or is covered by a thin mantle of soil and/or plant material. Limestone makes up approximately eighty percent of the volume of the aquifer formation. Water levels within the rock formation annually rise to the surface in response to summer and fall precipitation (the wet season), inundating vast portions of the area.

Local rainfall is a significant source of freshwater in the area. After intense precipitation, surface water is removed either through evapotranspiration, seepage to the underlying Biscayne Aquifer, or drainage through the L-31N canal along the eastern portion of the 8.5 SMA. Excess rainfall, particularly during the wet season, often inundates most of the 8.5 SMA, which historically contributed to the sheet flow that supplied surface water to the ENP on a regional scale. Canals, such as L-31N, tend to speed surface water drainage and preclude the natural seepage process to the underlying aquifer.

2.2.2 Natural and Cultural Resources

Prior to settlement and development, lands within this part of the eastern Everglades were a mosaic of wet prairies, freshwater marshes, and tree islands. Today, the 8.5 SMA is a patchwork of agricultural, residential and rural

development. Rural development and residential agricultural development is most concentrated in the eastern one-third of the area adjacent to the L–31N canal. Lower density residential and agricultural development with scattered vacant lots and wetlands comprise the central portion of the area. The western one-fourth of the area is dominated by a mixture of graminoid wet prairies and shrubby wet prairies with limited rural development. ENP lands, located adjacent to the 8.5 SMA, are mostly natural areas existing as a mosaic of long and short hydroperiod graminoid wetlands, interspersed with numerous willowheads, bayheads, and hardwood hammocks.

Most existing uplands in the 8.5 SMA have been converted for agricultural uses. This was accomplished by "rock plowing," a mechanical process that evened out the topographic high points and raised the surface of the intervening low points, allowing the cultivation of winter crops on the resulting gravelly soil created. Other upland areas have been developed for residential or commercial uses, employing land management practices that often discourage the growth of native plant species. Remaining undeveloped uplands generally contain dense stands of Australian pine and/or Brazilian pepper, sometimes intermixed with sparse areas of sawgrass.

There are four herbaceous wetland cover types in the Everglades: (1) Sloughs with deep, permanent water levels, (2) sawgrass marshes with semi-permanent water levels and long hydroperiods, (3) wet peat prairies, and (4) wet marl prairies with shorter hydroperiods. These are characterized by the average flooding depth and the duration of the flooding period, and by their predominant plant cover.

The vast majority of wetland features within the 8.5 SMA have undergone varying degrees of disturbance related to land clearing for agricultural or residential improvements and invasion by exotic species. Wetland communities exist primarily within the western portion of the 8.5 SMA, and sporadically within the central region of the area. Eastern portions of the 8.5 SMA are generally absent of recognizable wetland communities.

The native wetland communities of the 8.5 SMA range from freshwater marsh to wet prairie, dotted by tree islands. Tree islands are sometimes considered a wetland type, but generally occupy mounds on higher lands, where flooding is infrequent. This vegetation is underlain by a unique soil derived from exposed limestone and marl. Less-disturbed wetlands along the western extremity of the 8.5 SMA consist of muhly grass prairie community that dominates the landscape at higher surface elevations and sawgrass that dominates in the lower, wetter elevations. These plant communities generally exist in a mosaic of interspersed short and long hydroperiod wetlands. Within the more developed and disturbed areas of the 8.5 SMA, exotic species invasion and land management limits natural trends in plant dominance.

A variety of species listed as threatened, endangered, or of special concern occur or potentially occur in the study area. Federally listed species that could occur within the study area or be affected by construction and operation of the preferred plan include the snail kite, wood stork, Cape Sable seaside sparrow (CSSS), Florida panther, and eastern indigo snake. Species listed by the State of Florida as threatened, endangered, or of special concern include various reptiles, birds, fish, mammals, and mussels. Complete descriptions of all species of concern are included in the Final Supplemental Environmental Impact Statement (FSEIS). The on-going invasion by exotic trees, the altered hydrology of the marl prairies, the reduced hydroperiod, and the lack of preferred habitat within the 8.5 SMA reduces the potential for the occurrence of these species.

There are currently no known archaeological or historical sites within the 8.5 SMA. Although unrecorded archaeological sites were thought to be present at one or more of the numerous tree islands that were historically present within the 8.5 SMA, a cultural resource assessment survey encountered no archaeological or historic sites.

2.2.3 Socio-Economic/Political Conditions

An existing land use survey was completed in January 2000 by the Miami-Dade County Department of Environmental Resource Management (DERM). This study confirmed that, in general, the residential and agricultural areas are located on the eastern half of the 8.5 SMA and vacant land and wetlands are on the western half.

Utilizing information from the DERM Study, as well as information from various other sources, it was determined that the 8.5 SMA land is currently distributed as follows: approximately 41% is agricultural, 5% is residential, 5% is government owned, less than 1% is commercial, 2% is utility easements and 47% is vacant (Appendix E, Social Impact Assessment (SIA)). The overall existing residential density averages one unit per 20 acres. The agricultural land is utilized primarily for field crops. The western third of the 8.5 SMA is comprised mostly of mixed wetland hardwoods, freshwater marshes, and wet prairies.

The future use of land in the area is regulated by the adopted comprehensive plan for the governing local jurisdiction, as required by Florida law. The Comprehensive Development Master Plan (CDMP) for Miami-Dade County (adopted in May 1997 and amended in April 1999) establishes controls for future development in the 8.5 SMA. Consideration of one unit per 5 acres is possible only after drainage facilities become available to protect the area from a 1 in 10-year flood event.

The East Everglades Overlay Zoning Ordinance, adopted by Miami-Dade County in 1981, includes incentives to limit future development within the area by offering

transferable development rights. An “Open Land” classification is designated in the Land Use Element and the Land Use Plan Map for 2005 of the CDMP. This classification is intended for uses other than urban development, such as resource-based activities, recreation, and conservation. The 8.5 SMA is specifically identified in the CDMP as Open Land Subarea 4, East Everglades Residential Area.

2.2.4 Current Flooding Problems

The 8.5 SMA receives no flood protection benefits from the greater C&SF Project. As a result, the area is subject to frequent flooding problems, particularly during the wet season. Much of the development in the area occurred during the 1970’s, a decade of generally below normal rainfall with no major storms. In 1981, heavy rains associated with Tropical Storm Dennis (August through September) flooded the area and resulted in an extreme flooding event. This event also caused concern with the flooding of septic tanks and potential contamination of the groundwater.

Most recently (1999), Hurricane Irene impacted the 8.5 SMA with water levels similar to those experienced during Tropical Storm Dennis in 1981. Surface water levels in the area remained elevated long after the passage of the storm, resulting in property damage and loss of crops. According to the Miami-Dade County Agricultural Extension Service, losses throughout Miami-Dade County due to Hurricane Irene were approximately $77,000,000 for vegetables, $2,500,000 for field crops, $150,000 for aquaculture and $126,000,000 for ornamental crops. Values for agricultural damages specifically within the 8.5 SMA were not available.

Periodic high groundwater stages in the 8.5 SMA have attributed to the following: deterioration in unimproved roads; damage to septic tank systems; damages to potable wells due to septic tank problems; and damages to residences due to flooding. Agricultural interests in the 8.5 SMA have experienced periodic crop losses due to root zone inundation by elevated groundwater.

2.2.5 Flood Mitigation Needs

The GDM for the MWD Project, as authorized in 1992, provided for a flood mitigation system for the 8.5 SMA. This system was designed to mitigate for any increase in flooding that might result from higher stages associated with the MWD Project. It is a requirement of the reevaluation to analyze alternatives that provide no increase in flooding above and beyond what existed prior to the authorization of the MWD Project.

As the authorized MWD Project is implemented, the net increase in water introduced to NESRS is expected to raise groundwater elevations in adjacent (developed) areas of the East Everglades. As a result, the volume of groundwater storage available to retain rainfall runoff would be reduced and the area would be more susceptible to flood damages. The additional increase in flood depths would range from about 0.3-ft. in the north part of the residential area to about 0.1-ft. in the agricultural area. The planned mitigation system outlined in the 1992 GDM is designed to eliminate these increased stages with a system of levees, seepage canals and pump stations.

2.3 DESCRIPTION OF THE AUTHORIZED PLAN

The Authorized Plan for the 8.5 SMA is documented in "General Design Memorandum and Environmental Impact Statement and Appendices, Modified Water Deliveries to ENP, Part 1, Agricultural and Conservation Areas, Supplement 54, June 1992." The plan is shown on Plate 27 of the GDM and Figure 4 of this document. A description of how this plan was selected is included in Section 3.3.2, herein.

2.3.1 Description

The Authorized Plan includes a double levee surrounding the area to the north and west tied into L-31N and a seepage collection canal within the leveed area to convey seepage to a pump station at the northeast corner of the 8.5 SMA. The levee and seepage collection canal are designed to mitigate for increased flood risk as a result of projected increased water levels in NESRS and other portions of ENP. The outer levee would be constructed on the perimeter of the 8.5 SMA, terminating in the south at Richmond Drive. The seepage canal would be located approximately 500-ft. east of the center of the exterior levee. From north to south, the canal narrows and becomes shallower. The canal width ranges from 45-ft. in the north to only a few feet in the south. The canal depth ranges from 12-ft. in the north to approximately 6.5-ft. in the south. An inner berm is included to prevent sheet flow from the 8.5 SMA from entering the seepage collection canal. Pump station S-357 would be constructed at the northeastern terminus of the 8.5 SMA seepage collection canal to pump seepage water to L-31N for conveyance to ENP and NESRS via L-29.

2.3.2 Funding

According to the 1992 GDM, all first costs shall be 100% Federal responsibility and shall include the value of lands, easements, rights of way, and relocations required for construction of the project. Operation and Maintenance (O&M) and Repair, Replacement and Rehabilitation (RR&R) costs shall not be more than

75% Federally funded. Acquisition of lands for ENP expansion shall be in accordance with PL 101-229 and cost shall be the responsibility of DOI.

2.4 ITEMS OF CONCERN

A public scoping coordination process was developed and implemented during the early conduct of this study. From April to June 1999, input was received from various agency and stakeholder groups. Environmental, social, and economic issues were identified and included in a formal scoping letter distributed to the public in June 1999. Preliminary concerns listed in the scoping letter include:

- Effect on natural system and ENP
- Social, economic, and environmental effects on the residential community within the 8.5 SMA
- Water management to provide continued existence and recovery of the CSSS
- Effects on Native American interests
- Effects on farmlands within the 8.5 SMA and adjacent agricultural areas
- Potential contamination transport by surface and groundwater to the adjacent environment
- Secondary, cumulative impacts from providing flood protection beyond the flood mitigation plan

As a result of public comments received during the scoping process, additional concerns were identified. These include:

- Need to conduct a thorough scientific and engineering evaluation of all alternatives
- Long-term effects of the alternatives on surrounding natural and physical resources
- Cumulative impacts of alternatives relative to other features in the MWD project
- Complete economic analysis of all alternatives and their impacts

- Compatibility with the CERP and other related Everglades restoration projects
- Historic and cumulative loss of additional areas adjacent to the 8.5 SMA
- Water quality impairment from areas within and adjacent to the 8.5 SMA
- Impacts to recreational amenities currently enjoyed in the area
- Land use changes required or expected from each alternative
- Effect of schedule delay for completion of the project on existing natural and cultural resources
- Geographic extent of the study

2.5 ITEMS OF LOCAL COOPERATION

A primary component of local cooperation is the PCA. A PCA is a legally binding document between the Federal government and the local sponsor, identifying the sponsor and government duties and obligations for the project. The SFWMD, as the local sponsor for this project, represents local interests and has certain responsibilities for cost sharing and long term project maintenance and operation. A PCA, executed in September 1994, defined the responsibilities of the USACE and the SFWMD for the entire MWD Project, including the 8.5 SMA. If an alternative other than the Authorized Plan is selected, a PCA Amendment will be executed between the USACE and the SFWMD, defining the requirements of each party for implementing, maintaining and operating the system.

The specific requirements of local cooperation for the MWD Project will comply with the following guidelines according to the GDM:

a. "Contribute a minimum of 25% of total costs needed to operate and maintain, repair, replace, and rehabilitate the project works involved to mitigate the increased risk of flooding in the residential area including the levee and canal system, the pumping stations, and the structural works and modifications in the Water Conservation Area No. 3 and adjacent canals."

b. "Hold and save the United States free from damages due to the construction or subsequent operation and maintenance of the project, except any damages due to the fault or negligence of the United States or its contractors."

c. "Prevent encroachment on the flood-carrying capacity of the project including the culvert system under the U.S. 41 road."

d. "Maintain and operate the works after completion in accordance with regulations prescribed by the Secretary of the Army, except for the water control structures and outlets in Water Conservation Area No. 3, which will be maintained and operated by the Corps of Engineers."

2.6 ROLE OF PROJECT SPONSOR DURING PROCESS

In April 1999, the Governing Board of the SFWMD requested that the USACE develop and analyze a full array of alternatives for providing flood mitigation to the 8.5 SMA. Staff at the SFWMD worked with the USACE, along with other cooperating agencies, to develop the nine alternatives and two variations of an alternative, and provide the analysis as contained the Draft GRR/SEIS completed in April 2000. During the 45-day public comment period that followed, the Governing Board had the opportunity to evaluate each alternative and select a plan other than the Authorized Plan that it wished to support as a Recommended Plan.

If the Governing Board selected a locally preferred alternative (LPA) (alternative other than the Authorized Plan), then the SFWMD, as the local sponsor, would be responsible for paying any additional initial and O&M costs above that of the Federal plan. Shortly after the conclusion of the public comment period, the Governing Board passed a motion that stated that they considered Alternative 6D to be the "optimal" plan. The Board did not, however, name it as a LPA. A complete description of the motion and the recommendations of the SFWMD Governing Board is included in Section 8.1 herein.

2.7 PUBLIC COORDINATION

This reevaluation study has encouraged and facilitated public involvement since the onset of the project and included numerous public forums for residents, cooperating agencies, and affected stakeholders to present their issues and concerns. Table 1 summarizes public comment and interagency coordination to date.

Meetings held to specifically discuss this project included agency and stakeholder scoping meetings, technical team meetings, and formal public meetings. Comments were received from residents and non-residents, business owners, elected officials, special interest groups, tribal representatives and environmentalists. During formal public meetings, all input was documented on tape by a stenographer and comment cards were kept as a record. At the technical meetings, input was received from agency and tribal representatives,

special interest groups, and other various stakeholders. Cooperative efforts were pursued to gain an understanding of issues and include input in the most effective manner possible.

All public meetings were announced at least two weeks in advance while technical meetings were open to all interested parties who were notified via a network of electronic mail and telephone correspondence. In an effort to gather as much information and insight as possible, several visits were made to the 8.5 SMA, hosted by residents, business owners, and government agency and tribal representatives.

SECTION 3.0
PLAN FORMULATION

3.1 INTRODUCTION/FORMULATION METHODOLOGY

The plan formulation process involved identification of problems, development of alternative plans to resolve the problems, and evaluation and comparison of the alternatives. The following was accomplished:

- Problem Identification. Input was solicited from stakeholders on water and related land resources problems and opportunities specific to the area. An assessment was made of existing conditions and expected future conditions, and concise statements were developed about specific problems and opportunities.

- Development of Alternative Plans. Nine alternatives and two variations of an alternative were developed based on comments and feedback with affected stakeholders and coordinating agencies.

- Evaluation of Alternatives. Requirements and objectives were developed for the project, resulting in specific performance measures. Each alternative was evaluated to determine its performance toward meeting the project objectives and requirements.

- Comparison of Alternatives. Comparisons of the results for each alternative were made and presented.

A detailed discussion of each of these steps is presented in this GRR.

3.1.1 Previous Studies

The 8.5 SMA has been the subject of several previous studies that have set the stage for the current investigation. The most relevant of these studies are summarized and referenced in the following paragraphs. This summary provides some background of the plan formulation accomplished previously and that to be performed for this investigation.

The General Design Memorandum and Environmental Impact Statement, Modified Water Deliveries to ENP, June 1992. This document describes the evolution of alternative plans considered for improving water deliveries to ENP. It describes the relationships between hydrologic and ecologic conditions in the Everglades, historic conditions, the existing base condition (approximated by the "Base 83" condition used for this reevaluation), and the expected future condition of the Everglades without any project to improve water deliveries. The report

also explains the chronological formulation of alternative plans. The process of formulating alternative plans proceeded through a series of planning iterations, or steps, during which certain conditions led to the development of a set of alternative plans. These plans were evaluated and rejected or selected for further improvement and analysis. Basic alternative plans were developed to meet the objectives of location, timing and volume of water to be delivered to ENP. In addition, several measures were required to be added to plans to mitigate for induced flood damages in certain areas. The residential portion of the East Everglades (8.5 SMA) was one of the areas where mitigation was necessary.

Two basic approaches were investigated to reduce or prevent increased flood damages in the developed 8.5 SMA. The approaches were non-structural plans, including acquisition of all lands adversely impacted by the increased water depths, and various structural measures. These plans are summarized in the matrix shown in Table 16 of the 1992 GDM. Analysis of the various plans led to the selection and authorization of Plan G as the final Plan of Improvement for the 8.5 SMA. The plan is shown on Plate 27 of the 1992 GDM, and in Figure 4 of this GRR.

East Everglades 8.5 Square Mile Area Study Committee. On July 20, 1994, Governor Lawton Chiles issued Executive Order 94-187, establishing the East Everglades 8.5 Square Mile Area Study Committee. The Committee was charged with analyzing the hydrology and ecology of the 8.5 SMA within western Miami-Dade County and its relationship to the protection and restoration of ENP and Florida Bay. The Committee was further directed to study the environmental and economic impacts of alternatives designed to preserve the natural values of the region while protecting the 8.5 SMA. In April 1995, the Committee issued a report to the Governor presenting the results of its evaluation and recommendations to implement a flow-way/buffer alternative for the 8.5 SMA. A complete description of the work by the Committee can be found in the Report to Governor Lawton Chiles, dated April 1995.

District Review Team. In 1996 the SFWMD formed an interagency team to evaluate and oversee the development of the alternatives proposed by the Governor's Committee and others. It consisted of representatives from ENP, SFWMD, USACE, DERM, Florida Department of Environmental Protection (FDEP), and the United States Fish and Wildlife Service (USFWS). Working with a consultant team, this group developed and evaluated six alternatives to provide flood mitigation to the 8.5 SMA.

The analysis of these alternatives is contained in the Final Report, Alternative Land Use Analysis, Eight and One-Half Square Mile Area, August 1998, prepared by PEER Consultants ("the PEER Report").

3.1.2 Process for Developing Current Alternatives

Evaluation of these and some of the previous alternatives for the 8.5 SMA are the subject of this document. The following process was followed in developing the final list of alternatives for the 8.5 SMA:

- **Previous Studies.** The study team conducted a thorough review and evaluation of previous studies in order to gain an understanding of which features of structural and non-structural alternatives have potential to meet the goals, requirements, and objectives of the project. The technical and procedural analysis of these studies provided valuable technical insight during the process of identifying viable alternatives.

- **Technical Coordination Meetings.** A series of technical meetings was conducted by the USACE with coordinating and cooperating agencies, and affected stakeholders associated with the project. During these meetings, technical professionals suggested new alternatives for consideration as well as discussed merits of previously studied alternatives and suggested modifications.

- **Public Coordination Workshops/Meetings.** Numerous meetings and workshops have been held with the public since the development of the PEER Report. During these meetings, comments have been received from residents, concerned citizens, environmental advocates, and local, state, federal and tribal agencies. From July to October 1999, the public was given an opportunity to comment on eight alternatives presented for this project. Comments received, resulted in the addition of a ninth alternative for consideration and two variations of another alternative.

During the conduct of modeling and design, minor modifications to the features of several alternatives were added to improve cost-effectiveness and performance.

3.2 PROJECT CONDITIONS

The focus of this analysis is on the 8.5 SMA. However, due to the sensitive hydrologic interconnection of all components of the Everglades, discussion of the broader system is necessary to establish a basis for evaluation of alternatives. Therefore, the “base”, “existing”, and “future without project conditions”, for the broader system and the 8.5 SMA are presented below. For purposes of this analysis, the conditions are defined as follows:

- Base 83 (Pre-MWD): This is the condition of the study area as it existed prior to the MWD Project. It assumes stage and flow conditions and operations as authorized in 1983, and as still in effect in 1989.

- Base 95 (Existing): This is the condition of the study area as it exists today, as measured and observed during the conduct of this reevaluation.

- Future Without Project: This is the condition of the study area as it would be expected to exist in the future, after the MWD Project was implemented, including the Authorized Plan for mitigation of the 8.5 SMA. This is the base for which the "future with project" scenario will be compared.

A specific description of each of the project conditions is included in Section 4.5 of this report.

3.2.1 Base 83

Information contained in the 1992 GDM detailed the condition of the environment and resources within the MWD study area prior to the project implementation. It contains a snapshot of this broad area as it appeared to the MWD study team. As such, it represents the best information available for the background, conditions, and features of the MWD area for the Base 83 conditions. Therefore, the Base 83 project conditions, as established for the 1992 MWD GDM/EIS, have been used for this reevaluation for comparative purposes.

A summary of the pre-MWD project conditions was presented in the 1992 GDM, and is included below as a base for conditions as they existed prior to the MWD project.

C&SF Project. The C&SF Project provides essentially all water deliveries, other than direct rainfall, to the NESRS. In total, WCA 1, 2 and 3 include the largest remaining portion of undeveloped Everglades in existence. WCA 3 is the largest and southernmost of these areas, with a total size of about 915 square miles. L-67A and L-67 C divide the WCA into two segments, 3A on the west (760 square miles) and 3B on the east (155 square miles).

The operation of the project to deliver water to ENP has been governed by the requirements of PL 91-282, enacted in June 1970 following droughts in the early 1960's. This law established a minimum schedule of water volume to be delivered to ENP through three delivery points: Shark River Slough and two locations east of the study area. The minimum delivery to Shark River Slough was set at 260,000 acre-ft. annually, distributed in accordance with a monthly schedule of minimum water releases. In times of water shortage, the law allowed deliveries to be cut back to a volume representing 16.5 percent of the total volumes released from the C&SF Project.

Actual water volumes delivered from the C&SF Project through Shark River Slough to ENP are determined based on Federal regulations, the physical capabilities of the system, and management decisions of USACE, ENP, and the

SFWMD. The principal governing factor in deciding the volume of water to discharge is the stage (height) of water in WCA 3A. Operating practice has been to provide monthly deliveries as close to delivery schedule as is possible without a deficit whenever water in WCA 3A is below regulation schedule. This is done to maintain sufficient storage in WCA 3A both to ensure that water is available for subsequent ENP deliveries, and to satisfy other purposes of the project, such as storage for wildlife conservation and aquifer recharge.

When water released from WCA 3A is not sufficient to keep WCA 3A from exceeding its schedule stage, additional "flood" releases are made to lower the stage in WCA 3A. The S-12 structures are the main means of discharging floodwaters. Minor flood releases can also be made, under certain conditions, westward into Big Cypress and eastward, via S-151, into WCA 3B.

Average annual discharge of water into ENP through the S-12 structures for the period of January 1971 through December 1987 was about 392,000 acre-ft., which was 51 percent above the 260,000 annual minimum delivery schedule. The extra water was almost entirely a result of flood releases from WCA 3A that were made in order to keep the stage within the regulation schedule. Most of the excess was delivered during the months of July through October, which is during the normal wet season. The greatest release as a percentage of the delivery schedule occurred during the period March through August.

Water Quality. The quality of water delivered to ENP is frequently influenced by urban and agricultural activities elsewhere in the watershed. Of particular concern are floodwaters released from the Everglades Agricultural Area (EAA) into WCA 3A. The Everglades is a nutrient poor system and the introduction of nutrients, particularly phosphorus, from the agricultural areas is thought to have significantly affected sawgrass and wet prairie habitat in the water conservation areas through which EAA discharges pass en route to ENP. Large acreage in WCA Nos. 1, 2, and 3 has been converted to cattail, an otherwise uncommon plant in the Everglades, as a result of nutrient increases. Lower in the WCA system, particularly in the southern portion of WCA 3A and in the Shark River Slough, there is yet relatively little conversion to cattail. This is thought to be the result of the removal of nutrients upstream. Water that reaches the S-12 release structures in L-29 through sheet flow over WCA 3A showed phosphorus levels of less than 10 parts per billion (ppb) total phosphorus, whereas water delivered through the L-67A canal frequently exceeded 30 ppb total phosphorus. However, total phosphorus concentrations vary seasonally with annual rainfall amounts and were often higher following periods of severe drought. The average seemed to vary between 8 and 15 ppb.

Periphyton. Periphyton is the community of small to microscopic algae that grow attached to the stems and leaves of the dominant prairie and marsh plants. They are believed to be a crucial component of the marl-forming process. Loss of historic inflows has reduced the aquatic productivity of ENP by reducing the

aerial extent of the periphyton community. Reduced flows also appear to have affected periphyton species composition. Studies have shown that the taxonomic composition of periphyton in ENP was significantly correlated with hydroperiod length and soil percent organic matter, which are both largely regulated by water management activities. Shortened hydroperiods and low percentages of soil organic matter favored the development of blue-green periphyton over other groups of algae, such as diatoms and green algae. Other studies have shown that both fish and invertebrate grazers selected against blue-greens, favoring diatoms or green algae as a preferred food source.

Vegetation. Wetland communities occupy most of the East Everglades. The most common community in the East Everglades is sawgrass marsh (about 37% of the area as stated in the 1992 GDM), with the combined mesic grass communities, such as muhly grass and beard grass, ranked second (about 30% of the area). In the NESRS, some ecological modifications to the natural plant communities occurred because of the changed hydroperiod and fire patterns.

Beginning in the 1930's, several exotic plant species became established in parts of ENP and adjacent areas. Aquatic weeds are present, but have yet to pose a major problem in ENP. Three woody exotics pose threats to ENP: Casuarina (Australian Pine), Melaleuca (Cajeput Tree), and Schinus (Brazilian Pepper). While exotics invade a variety of natural plant communities, their spread in wetlands is attributed primarily to the decline in vigor and health of the natural communities, mostly associated with reductions in water depths and hydroperiods. The invasion of Melaleuca has been a problem in NESRS.

Birds. About 300 species of birds have been identified in ENP. Southern Florida's location makes it a migratory crossroads for West Indian and Central and South American birds; numerous North American species are residents. Many of this continent's species of wading birds, shorebirds, and waterfowl are represented here at some time of the year. Many of them are nesting residents, including some which seldom range farther north and others that have disappeared from areas where they once occurred.

Beginning in the early 1960's, the distribution of water deliveries affected wading birds mainly in two ways. First, the concentration of southward water flow in the Everglades into the northern portion of ENP resulted in a longer hydroperiod in the wetlands that received the flow, and in long-delayed and incomplete dry season drawdowns. Often, food was never sufficiently concentrated and available to support major wading bird nesting attempts. Or, as was commonly the case with wood storks, food became available only late in the dry season, and nesting was delayed so that it could not be completed before the beginning of the summer rains. Second, the already reduced foraging area available to wading birds was sharply diminished by eliminating flow to NESRS. This probably resulted in a substantial decline in aquatic productivity and loss of a significant portion of the available early dry season feeding habitat. Loss of these

early season foraging areas meant that storks shifted their feeding to the more deeply flooded central Shark River Slough. Thus, it abruptly became the drier years, when water was low enough in the central slough to support early winter foraging by waders, that became the successful nesting years.

Fisheries. ENP's waters support a large variety of fish in both freshwater and saltwater habitats. Fish populations in ENP's portion of Shark River Slough are seasonally and annually variable, being affected by both ambient and antecedent water conditions. Density and diversity are highest during extended high-water periods without severe drawdown. In contrast, high water conditions without seasonal fluctuations do not make fishes available to wading birds. Fish populations in NESRS are about thirty percent less dense than those in the slough marshes within ENP. These lower densities are attributed to the long-term reduction of hydroperiods in NESRS marshes since the early 1960's.

Endangered Species. In 1992, the MWD study area included sixteen animal species that were listed as threatened or endangered under the Endangered Species Act. The EIS attached to the 1992 GDM includes additional information about these species.

Fire. In the drier conditions of the last four decades, destructive fires, primarily of the incendiary dry season type, have destroyed or damaged numerous tree islands, pinelands, and wetlands with organic soils in ENP. Many of these fires have entered ENP from East Everglades, where unusually dry conditions have permitted fires to spread rapidly and broadly. These fires, along with unfavorable hydrologic conditions, have weakened individuals of native plant species, permitting the establishment of exotic species, particularly Schinus on tree islands and Melaleuca in marshes and islands.

Development in East Everglades. Human development in the study area in the early 1990s was limited to the East Everglades. This included about 6,900 acres primarily in residential development, about 5,600 acres in agricultural development, and about 107,600 acres in the southern portion of NESRS in private and public ownership (SFWMD owned 35,000 acres) that is essentially undeveloped. There were approximately 8,300 private owners in the NESRS portion of the East Everglades.

Residential Development. Residential land lies primarily in a narrow tract parallel with and extending several miles west of L-31N. In 1978, there were 139 permanent homes, including 60 mobile homes, in the area serving as residences for farmers and commuters to Miami. The total resident population of the entire East Everglades in 1992 was estimated to be 430 individuals.

Much of the East Everglades has been prone to flooding. Recognizing the wetland nature of much of the area, zoning restrictions were imposed by Miami-Dade County to curtail further residential development. However, current zoning

restrictions have not been enforced. Parts of the residential area are developed more densely than the current zoning would allow because many houses in the area were constructed when the zoning limit was one unit per five acres.

Commercial Development. Commercial enterprises in the East Everglades were along the eastside and consisted of several nurseries, a kennel, a fruit-packing house, and a rabbit farm. On the Tamiami Trail, there was a commercial airboat operation, a gas station, a restaurant, and souvenir shops.

Agricultural Development. About 3,000 acres of land were under agricultural cultivation within and adjacent to the East Everglades residential area paralleling L-31N. In the order of total acreage planted, the primary crops were: winter vegetables (tomatoes, squash), tropical vegetables, tropical fruits (Persian limes, lemon-limes, mangoes), and ornamentals. The Natural Resource Conservation Service (NRCS) of the U.S. Department of Agriculture considered the area to be unique farmland because it is in a frost-free climate permitting the production of winter crops.

Recreation. ENP is the primary recreational resource in the study area. In 1992, the average annual Park attendance was estimated at about one million visitors. ENP contains numerous sites and interpretive trails for observing the natural environment. At Flamingo, which is adjacent to Flamingo Bay at the southern tip of mainland Florida, there are facilities for boating, fishing and camping. Chekika State Park, located on Grossman Hammock in the East Everglades, included camping, picnicking, and interpretive nature facilities. The Kendall Gliderport near the State Park provided opportunities for soaring and skydiving. Most of NESRS was used for recreational activities such as air boating, hunting, and fishing.

Cultural Resources. The MWD study area contained several cultural resource sites. Historical use of the Everglades by aboriginal peoples is evidenced primarily by black earth middens and burial grounds, both usually located on high ground such as tree islands. The middens were typically seasonal camps used by small bands of people in foraging for wildlife and growing food crops. The Shark River Slough contains many such middens or burial grounds located on the characteristic tree islands. The site of Fort Henry, the Army supply depot in the Everglades during the Seminole Wars, is located in the East Everglades. Approximately ten sites in the East Everglades are now included on the State of Florida Archives Master Site File and many more lie within ENP.

3.2.2 Base 95

This represents existing conditions related to the operating plan currently in effect as authorized in the 1995 experimental deliveries plan for hydrologic conditions. All other conditions of concern are being addressed in detail in the FSEIS. A summary of existing conditions is included below.

Hydrologic Conditions. Local rainfall is a key component of the local hydrology in the 8.5 SMA. The area receives an average of about 58 inches per year. Rainfall often saturates the local aquifer, resulting in standing water throughout much of the area. Groundwater flows toward the east and southeast. The Biscayne Aquifer, the principal surficial aquifer in southeast Florida, is between 60 and 150-ft. in the region and breaches the surface throughout the 8.5 SMA. These outcrop areas can be a significant source of recharge for the aquifer.

Potable water is provided through private wells and wastewater is treated using individual septic systems. Phosphate and nutrient levels fall within the range expected for mixed residential/ agricultural areas. Elevated pesticide levels have not been documented in the 8.5 SMA.

Monitoring wells in the 8.5 SMA have detected low levels of heavy metal. A U.S. Geological Survey (USGS) study indicated that groundwater in a shallow monitoring well in the 8.5 SMA detected no anthropogenic fecal coliform/fecal streptococci (FC/FS) bacteria.

Vegetation and Wildlife. The native vegetative communities within 8.5 SMA include marl prairies (graminoid- and herb-dominated), shrubby wetlands, forested wetlands (both native and exotics dominated), and shrubby uplands. Many of these communities, particularly in the eastern portion of the 8.5 SMA, have been soil disturbed.

Conditions within the 8.5 SMA likely provide important resources to opportunistic small animals of avian, mammalian and reptilian origin. Species that depend upon wetlands for critical resources dominate, including 142 species of birds, 21 species of mammals, several small fish species, two species of frog, and a variety of aquatic invertebrates representative of Everglades wetland complexes.

The primary federally listed species in the region are the snail kite, wood stork, and CSSS, with the latter of particular concern for the 8.5 SMA and adjoining parklands. The CSSS is an endemic bird species restricted to six subpopulations within short-hydroperiod wetlands of the southern Everglades and Big Cypress Swamp. Sparrow populations have experienced precipitous declines since the early 1980s. Subpopulation F is located immediately southwest of the 8.5 SMA. Areas that sustain the short hydroperiod prairies are considered essential for the sparrow to successfully breed and to ensure the survival of the species.

Air Quality and Noise. Miami-Dade County was redesignated on April 25, 1995, as attainment for ozone under the 1990 Clean Air Act in CFR, Part 81, and is currently classified as an air quality maintenance area. Noise impacts are not an issue.

Socio-Economic Setting. Residential and agricultural uses are predominant to the eastern half of the 8.5 SMA, with vacant land and wetlands dominating the western half. Approximately 1,625 acres along the western periphery are in public holding. Miami-Dade County's CDMP designates the 8.5 SMA as "Open Land," which is intended for uses other than urban development, such as recreation and conservation. The County currently provides fire and emergency services for the 8.5 SMA, plans and coordinates all emergency medical rescue activities, and provides police services. Electricity is provided by Florida Power and Light (FPL) and telephone service is provided by Bell South. The County currently does not provide water, sewer, solid waste, or mass transit services to the 8.5 SMA, but currently maintains approximately 2 miles of roadway on SW 136th Street from the junction of L-31N to approximately 202nd Avenue.

The western portion of the study area overlooks adjoining ENP parklands, famed for its expansive, picturesque marshes, wet prairie, and tree islands. Several opportunities for passive recreation, such as hiking, birding, and nature photography are available in the publicly owned lands in western portions of the 8.5 SMA.

Prime And Unique Farmlands. Although no prime farmland occurs within the 8.5 SMA, most of the 8.5 SMA qualifies as unique farmland. There are approximately 2,642 acres of agricultural land within the 8.5 SMA, featuring a variety of row and field crops, trees and ornamental plant nurseries, and specialty farms.

Hazardous Materials. A review of available Federal and State lists suggests that the 8.5 SMA has not been directly impacted by hazardous or petroleum wastes or products. The presence of underground fuel tanks within the 8.5 SMA constitutes a potential source for petroleum contamination of the Biscayne aquifer due to its close proximity to ground surface and the shallow water table. However, no contamination has been documented.

Cultural Resources. There are no known archaeological or historical sites within the 8.5 SMA. A cultural resource assessment survey of the 8.5 SMA encountered no archaeological or historic sites. State Historic Preservation Office, in a letter dated June 22, 2000, concurred that no significant cultural resources would be affected by the project. The Miccosukee Tribe owns one undeveloped parcel in the 8.5 SMA.

3.2.3 Future Without Project Condition

The Future Without Project condition represents the condition of the study area as it would be expected to exist in the future, after the MWD Project was implemented, including the Authorized Plan for mitigation of the 8.5 SMA. Under this scenario, all components of the MWD Project would be allowed to be

operated as generally described in the 1992 GDM and specifically described in subsequent study and design efforts. This would result in increased stages and flows in the NESRS from water released from WCA 3A and 3B. The levee and seepage canal system constructed around the 8.5 SMA would provide flood mitigation from these increased flood stages. Consequently, increased stages in ENP would restore flows and hydropatterns to the ENP expansion area as predicted in the 1992 GDM. This condition was determined in the GDM, and approved by the Secretary of the Army, as meeting the goals of the 1989 Everglades National Park Protection and Expansion Act.

An estimate of the environment for this condition has been projected as a result of this reevaluation. A description of the natural and physical environment expected from the implementation of the Authorized Plan is provided in Section 4.4 of the FSEIS.

3.2.4 Specific Problems and Opportunities

The categories of issues facing the study team in evaluating the alternatives include structural, operational, environmental, hydrologic, social, economic, and others. Some of the specific issues that were considered for each alternative include:

- Accommodating the goal of getting the appropriate quantity, location, and timing of water into the NESRS and ENP Expansion areas, as defined in the 1992 GDM.
- The difference of providing flood protection versus flood mitigation within the 8.5 SMA and the effect on hydrologic conditions within the ENP.
- The number and nature of residential units that will be impacted or taken.
- Impact on adjacent areas outside of the 8.5 SMA.
- Local Costs.
- Long term O&M cost considerations.
- Operational requirements and compatibility with the existing system.
- Potential future use of areas after plan is implemented.
- Needs for infrastructure improvements within 8.5 SMA.
- Impact on wetlands.

- Impact on natural habitat for flora and fauna.
- Water quality impacts.
- Water supply impacts.
- Impact on existing or future restoration or protection projects in the area.
- The schedule of implementation for each alternative.

3.3 PLANNING CONSIDERATIONS

3.3.1 General

As a result of the ENP Expansion Act, the Secretary of the Army was tasked to develop a solution that would accomplish two primary goals:

1) Provide restoration of natural hydrologic conditions in ENP relative to timing, location and volume of surface and ground water.

2) Mitigate the impacts to the residents of the 8.5 SMA from higher water stages resulting from the MWD Project.

These goals present a challenge of implementing a solution that would address the conflicts between environmental restoration goals of the ENP and flood mitigation needs of the community (8.5 SMA landowners and residents).

3.3.2 Previous Evaluations

1992 MWD GDM. This study included the evaluation of several mitigation alternatives to "reduce or prevent increased flood damages in the developed East Everglades area" (including the 8.5 SMA). Alternatives included both non-structural and structural measures as described below:

Non-Structural Measures

- Land Acquisition – Total acquisition of all land and property within the 8.5 SMA.
- Flowage Easements – Acquisition of perpetual flowage easements for all property within the 8.5 SMA.

Structural Measures

- Plan A – Double levee north and west of residential (8.5 SMA) area; single levee south; single pump of seepage water into NESRS.

- Plan B – Double levee north and west of residential area, continuing south to include agriculture area (south of 8.5 SMA); two pumps for seepage water into NESRS.

- Plan C – Same canal, levee and pump alignments as Plan A; sizes increased for additional flows.

- Plan D – Double levee system for only the developed area on north and west side of 8.5 SMA; single levee on south side; internal canal and pump S-357 to return seepage water from L-31N; pump S-356 to discharge flows into NESRS.

- Plan E – Same levee and canal alignment as Plan D; internal pump S-357 discharge seepage and flood flows into L-31N; pump S-356 discharge flows from L-31N to L-29.

- Plan F – Same levee, canal and pumps as Plan E except levee on south side of area eliminated.

- Plan G - Same layout of canals and levees as Plan F; pump S-357 located on northeast corner of 8.5 SMA and discharge into L-31N; seepage canals on west and north sides sized to convey additional flows.

A detailed description of each of the above alternatives can be found in the 1992 GDM.

Plan G was selected because it was the lowest cost plan of all of the alternatives evaluated and met the objectives of the MWD Project. This was the plan that the USACE was authorized to construct under the provisions of the 1989 Everglades National Park Protection and Expansion Act.

East Everglades 8.5 SMA Study Committee. In 1994, Governor Lawton Chiles established the East Everglades 8.5 Square Mile Area Study Committee for the purpose of evaluating the recommendations of the USACE in the MWD GDM. This committee evaluated three types of alternatives:

- Land Acquisition Alternatives – These included full buy-out, partial buy-out, and voluntary buy-out.

- Structural Alternatives – The USACE authorized plan and variations.

- Flow-Way and Flow-Way/Buffer Alternatives – A flow-way seepage collector system of swales in place of canals and levees.

The committee determined that the flow-way/buffer alternative was the best and should be adopted as the LPA. A full description of the analysis by the Governor's committee can be found in its *Report to Governor Lawton Chiles*, April 1995.

PEER Report. In response to the Governor's East Everglades 8.5 SMA Study Committee, the SFWMD contracted PEER Consultants, P.C. to evaluate the flow-way/buffer and other alternatives for the 8.5 SMA. This consultant team developed and evaluated the following six alternative plans:

1. USACE Authorized Plan - As described in the MWD GDM (Plan G).

2. Modified USACE Authorized Plan – Several pumps discharge seepage water from the west perimeter levee to the ENP.

3. Water Preserve Areas – Western part of 8.5 SMA used as shallow impoundment to treat seepage water discharged from the 8.5 SMA.

4. Modified Water Preserve Area – Same as 3 except boundaries of the protected area revised.

5. Seepage Barrier – Impermeable barrier around perimeter of 8.5 SMA eliminates seepage flow into the protected area.

6. Total Buy-Out – Acquisition of all property within the 8.5 SMA.

A complete description of the analysis conducted by PEER can be found in the report titled *Alternative Land Use Analysis, 8.5 SMA (1998).*

3.3.3 Technical Issues

There are several technical issues that were considered during the development of the alternatives for this reevaluation. They are described below.

Relation to Other Components of and Related to the MWD Project. The flood mitigation for the 8.5 SMA is only one of several components of the MWD Project that is currently being reevaluated. Specifically, modifying a portion of Tamiami Trail, and the control of seepage and conveyance from WCA 3A and 3B, are very much related to the hydrology of the 8.5 SMA system. In addition, the C-111 project located south of the 8.5 SMA and the CERP will have an influence on this project. Very close coordination was required by the 8.5 SMA

study team to assure that effects from these projects were considered in this evaluation.

Flood Mitigation and Flood Protection. Flood mitigation, for the purposes of this project, was defined as having no increase in stage for a given future flood event above that which would be experienced under conditions prior to the MWD project. Seven of the structural alternatives were defined to provide flood mitigation (Alternatives 1, 2B, 6C, 6D, 7, 8A, 9).

Two of the structural alternatives were defined to provide flood protection (Alternatives 3 and 6B). Flood protection, as defined by the USACE for this project, is protection from ground surface inundation for a 1 in 10-year flood event. In the 8.5 SMA, a ground surface elevation of 7.7- ft. was determined to be the elevation above which lands would be afforded flood protection. In addition, Miami-Dade County has a definition of flood protection that it uses to define development opportunities in the County. This is defined as the protection from inundation from a 1 in 10-year storm event. Calibrations of the Miami-Dade County flood protection criteria to the USACE flood protection criteria showed that the County criteria would be met in all areas where flood stages remained below the USACE's defined protection stage of 7.7- ft.

The remaining two alternatives (Alternatives 4 and 5) provide flood mitigation through non-structural measures.

Structural and Non-structural Mitigation Measures. Much like the previous studies on the 8.5 SMA, the study team evaluated both structural and non-structural methods for providing flood mitigation and protection. The structural methods included features such as levees, canals, berms, swales, pump stations, and seepage barriers. The non-structural methods included fee simple land acquisition, flowage easements, or life estates with flowage easements. It was anticipated that physical constraints and conditions may not allow for structural methods alone to meet the mitigation or protection goals of an alternative. In those cases, non-structural alternatives would be used to supplement structural methods when the structures alone could not provide the levels or coverage of mitigation or protection desired.

Modification of Alternatives. The initial development of structural alternatives was conducted largely without benefit of technical evaluation to determine specific structure sizes and capacities. Therefore, the initial design was performed based on previous studies and best professional judgement. After the features were set, the alternative was run through a very complicated and time consuming hydrologic model. If the model showed that an alternative did not meet the mitigation or protection goal, then it could be adjusted, or redesigned, and rerun in the model. This process could be repeated, each time adjusting the features of the system, until the alternative either met the performance goal, or showed that physical constraints would not allow it to perform as intended.

These adjusted alternatives were designated by number and letter and include Alternatives 2B, 6B and 8A (Alternatives 6C and 6D are variations of Alternative 6B and not a result of model refinements).

3.4 ALTERNATIVES CONSIDERED

One of the objectives of conducting this new analysis of alternatives was to evaluate as many feasible alternatives as could be reasonably accommodated within available time and resources. The original MWD Project goals were considered minimum requirements for each alternative: restore hydrologic flows to the ENP while providing flood mitigation to the residents in the 8.5 SMA. The following alternatives were developed for evaluation:

Alternative 1	Authorized GDM Plan
Alternative 2B	Modified GDM Plan
Alternative 3	Deep Seepage Barrier Plan
Alternative 4	Landowner's Choice Land Acquisition Plan
Alternative 5	Total Buy-Out Plan
Alternative 6B	Western Portion of 8.5 SMA as Buffer Plan
Alternative 6C	Modified Western Portion of 8.5 SMA as Buffer Plan (Save our Rivers Boundary)
Alternative 6D	Modified Western Portion of 8.5 SMA as Buffer Plan
Alternative 7	Raise All Roads Plan
Alternative 8A	Western Portion of 8.5 SMA as Flow-way Plan
Alternative 9	Adaptive Refinement of GDM Plan

Alternatives 6C and 6D are variations of Alternative 6B

A discussion of each of these alternatives is included in the following sections. Specific features of each alternative, including dimensions of structures, are included in Table 2. Each alternative is shown graphically in Figures 4 through 14.

3.4.1 Alternative 1 – Authorized GDM Plan

The Authorized Plan for mitigation of the 8.5 SMA that is outlined in the GDM was prepared by the USACE, Jacksonville District in 1992. It includes a major levee along the 8.5 SMA perimeter starting at the L-31N on the north side of the area, and moving west and south to high ground on SW 168th Street. A seepage canal will be constructed adjacent to and just inside of the major levee to collect groundwater underflow. A minor levee, or berm, will be constructed adjacent to and just inside the seepage canal to prevent surface water flow from running into the canal from the 8.5 SMA. There is concern that runoff from the 8.5 SMA could possibly be polluted, and the interior berm will keep potentially contaminated water from mixing with the cleaner seepage water from ENP. This alternative offers flood mitigation for all residents of 8.5 SMA.

A new pump structure (proposed S-357) will be located in the canal at the northeastern edge of the 8.5 SMA near the L-31N canal. This pump will discharge water from the seepage canal into L-31N. A future pump structure S-356 (not included in this project) will pump from L-31N canal into L-29 canal. This system will re-circulate cleaner seepage water back to NESRS and ENP. Surface water runoff from within the 8.5 SMA will be contained by the berm, and eventually infiltrate into the ground. See Figure 4 for details of this alternative.

3.4.2 Alternative 2B – Modified GDM Plan

The development of this alternative was a direct result of the completion of the C&SF Restudy plan sent to Congress in July 1999. Many of the scoping comments received requested that the Authorized Plan be modified to be more compatible with other projects (i.e., C-111 and CERP). This Alternative was developed to address this issue. This alternative has the same basic layout of Alternative 1, and also provides flood mitigation for all residents of 8.5 SMA. It includes the same basic major levee, seepage canal, and interior berm system along the 8.5 SMA boundary southwest from L-31N to high ground on SW 168th Street. Three iterations of the model runs were required before the design of the system was optimized. The final iteration, called “2B” included a single pump (proposed S-357) installed at the southwest corner of the 8.5 SMA at the seepage canal at SW 168th Street. This structure will discharge seepage water south to a treatment area in the C-111 System, via a 96-inch diameter pipeline. As in Alternative 1, surface water runoff from within the 8.5 SMA will be contained by the berm, and will infiltrate into the ground. See Figure 5 for further details of this alternative.

3.4.3 Alternative 3 – Deep Seepage Barrier Plan

This alternative reevaluated work from previous studies that considered constructing a deep seepage barrier around the protected area. The intent was to reduce or eliminate groundwater underflow from the ENP Expansion area to the 8.5 SMA. This was designed as a flood protection plan that would provide protection from a 1 in 10-year flood event. Under this plan, the outer perimeter levee follows the same alignment as the Authorized Plan, along the 8.5 SMA boundary southwest from L-31N to high ground on SW 168th Street. A seepage barrier follows the same path (located within the levee). The seepage barrier will be made of an engineered barrier or curtain wall such as slurry wall, sheet piles, etc. The barrier must be installed at an elevation below the aquifer (estimated 50 to 70-ft.). This will eliminate the need for the seepage canal and interior berm. Surface water runoff from within the 8.5 SMA will be contained by the levee, and infiltrate or run overland into L-31N, and be controlled by existing structures in the L-31N canal. A graphic representation of this alternative is shown as Figure 6.

3.4.4 Alternative 4 – Landowner's Choice Land Acquisition Plan

Many of the comments received in the scoping process suggested that the residents may respond more favorably to a voluntary land acquisition alternative. Many residents indicated that they would be willing to stay and endure the increased flooding if they were shown the extent of the impact. Therefore, an alternative was developed by the study team that provided for acquisition of land in the 8.5 SMA through three different means. Current owners have a choice:

a) Buy-Out: Government purchase (fee simple)

b) Flowage Easement: Pay property owners cash as mitigation for periodic flooding. Owner retains ownership rights to property.

c) Life Estates with Flowage Easement: Pay property owners cash as mitigation for periodic flooding. Owners retain ownership and use of property for duration of current owner's life. Then the property goes to ownership of the Government.

Specific rules and assumptions regarding these choices are detailed in Appendix D - Real Estate. Modeling would be performed to graphically demonstrate to the owners the elevations and extent of flooding. This will assist the owners in making their choice.

Under this alternative, no canal, levees, or pumping structures are proposed. A graphic representation of this alternative can be seen in Figure 7.

3.4.5 Alternative 5 – Total Buy-Out Plan

Total buyout was originally developed and evaluated as an alternative in the 1992 GDM. The Governor's East Everglades 8.5 SMA Study Committee also considered total buyout as an alternative, as did the PEER Report. Under this plan, all land in 8.5 SMA will be obtained either from willing sellers or by condemnation. No structural improvements are proposed. Consideration for demolition of existing structures, restoration of natural conditions and long-term maintenance needs were included in the evaluation of this alternative. An illustration of this alternative is shown in Figure 8.

3.4.6 Alternative 6B – Western Portion of the 8.5 SMA as Buffer Plan

The Governor's East Everglades 8.5 SMA Study Committee developed and evaluated several alternatives that utilized the western portion of the 8.5 SMA as a buffer area. This concept was further studied in the PEER Report and the analysis confirmed that it was a feasible concept. Therefore, the 8.5 SMA technical team developed an alternative that would convert the western portion of the 8.5 SMA to be used as a buffer between the developed area and ENP. This was designed as a flood protection alternative. Part of the 8.5 SMA will have a perimeter flood protection levee that runs approximately along 202nd Avenue south to 168th Street. A seepage canal is located just inside (i.e., east) the new levee and is designed to collect groundwater underflow. An interior berm located just inside the seepage canal will prevent surface water portions of the 8.5 SMA from running into the seepage canal and mixing with seepage water. A new proposed pumping structure (S-357) located at the southern terminus of the levee/canal system will discharge seepage through a 96-inch diameter pipe to be released south into a treatment area in the C-111 project area. The feature of this plan is shown in Figure 9.

The alignment of the proposed levee/canal system was chosen to be approximately 202nd Avenue for several reasons. First, this road generally runs along a topographic ridge, which would help minimize the height of the proposed levee needed to contain the flood stages. Also, from information obtained at field visits and review of aerial photography, this road seems to represent the western edge of the more densely developed area within the 8.5 SMA. This alignment appeared to the technical team as a best chance of minimizing the cost of construction and the number of relocations required. Three iterations of the model runs were required before the design of the system was optimized. The final iteration, called "6B", included the features as described above.

3.4.7 Alternative 6C – Modified Western Portion of 8.5 SMA as Buffer Plan (Save Our Rivers Boundary)

Alternative 6C was developed based on a request from the SFWMD following the public presentation of this report on April 12, 2000 and is similar in nature and design to Alternative 6B. This alternative, shown in Figure 10, consists of an exterior and interior levee as well as a seepage canal generally constructed as shown. The location of the levee and canal system generally follows the eastern boundary of the area designated by SFWMD as the Phase 1 - Save Our Rivers (SOR) boundary. This area has been the subject of willing seller property acquisition by SFWMD as part of the SOR program.

A seepage collection canal will be located between the levees designed to keep the groundwater levels within the eastern portion of the area at the same levels as existed prior to the implementation of the MWD Project. The interior levee is positioned to prevent surface water from entering the seepage canal. A new proposed pumping structure (S-357) located at the southern terminus of the levee/canal system will discharge seepage through a 96-inch diameter pipe to be released south into a treatment area in the C-111 project area.

3.4.8 Alternative 6D – Modified Western Portion of 8.5 SMA as Buffer Plan

Alternative 6D is similar in nature and design to Alternative 6C. This alternative consists of an exterior and interior levee as well as a seepage canal generally constructed as shown on Figure 11. The location of the exterior levee is generally inside the Phase 1 - SOR boundary line that the outer levee for Alternative 6C follows. The seepage canal system runs along 205th Avenue north from 168th Street to 132nd Street, then east along 132nd Street to the L-31N canal. The seepage collection canal is designed to keep the groundwater levels within the area interior of the outer levee at the same levels as existed prior to the implementation of the MWD Project. Two interior levees, one on either side of the seepage canal, are positioned to prevent surface water from entering the seepage canal. A new proposed pumping structure (S-357) located at the southern terminus of the levee/canal system will discharge seepage water through a 96-inch diameter pipe to be released south into a treatment area in the C-111 project area.

The canal and levee system on the western boundary of this alternative ranges from approximately 0.22 to 1.1 miles west of the boundary of Alternative 6B, depending on the location along the boundary. Similarly, it is located approximately .10 to 1.05 miles east of the westernmost boundary of the 8.5 SMA. This alternative includes approximately 5.5 square miles within its boundaries, which is 2.1 square miles more than Alternative 6B.

3.4.9 Alternative 7 – Raise All Roads Plan

As mentioned in the discussion of Alternative 4, public comments indicated the desire to allow use of the land within the 8.5 SMA after the implementation of MWD Project, even without flood protection measures. The technical team developed an alternative that would improve roadway features within the area. This would be accomplished by raising all existing roads and restoring them in-kind. The roads will be raised so that they will not be flooded as a result of the MWD Project. All areas within the roads will remain unimproved. Roads will be improved only to the condition in which they currently exist (paved will be paved, dirt will be dirt). Mitigation for other areas will be handled by obtaining flowage easements. Due to the nature of the subsurface conditions in the area, much of the surface water is expected to infiltrate. It is probable that septic tanks for numerous residences will require upgrading due to the higher water levels. Specific assumptions for providing mitigation through flowage easements are included in the Real Estate Appendix. This alternative is illustrated in Figure 12.

3.4.10 Alternative 8A – Western Portion of 8.5 SMA as Flow-way Plan

This alternative evolved as a modification of the flow-way concept originally evaluated by the Governor's Study Committee. It uses a similar concept to Alternative 6B to protect the eastern, most inhabited portion of the area, and keep the western area as a more natural, undeveloped area. This western area will serve as a buffer zone to ENP west of the mitigation levee and as a natural flow-way for diverting flow from ENP to the C-111 area. The alignment of the proposed flow-way system was chosen to be approximately along the 7.0-ft contour. This represents general a topographic ridge, which would help minimize the height of the proposed levee needed to contain the flood stages. Also, as similarly described in the discussion of Alternative 6B, this alignment seems to represent the western edge of the more densely developed area within the 8.5 SMA. This alignment appeared to the technical team as a best chance of minimizing the cost of construction and the number of relocations required.

Two iterations of the model were run to optimize the layout of this alternative. The second iteration, called "8A", included an interior perimeter levee starting just north of 120th Street, running south and west around the Federal Aviation Authority (FAA) tract, along 202nd Avenue down to 168th Street. An exterior diversion levee will run approximately parallel to the interior levee and serve as a containment barrier for a natural swale flow-way. The containment levee will be small enough to allow surface water flow from ENP into the flow-way, but big enough to direct flow contained within the flow-way. A new proposed structure (S-357) located at 168th Street will discharge seepage water south into a treatment area in the C-111 system. Features of this alternative are shown in Figure 13.

3.4.11 Alternative 9 – Adaptive Refinement of GDM Plan

Numerous comments were received during public coordination and within technical team discussions referencing the need to develop a plan that would be compatible with the CERP. This alternative evolved as a plan that is capable of integrating immediately with the system operation for implementation of the MWD Project, but constructed in a manner that can be modified to comply with the CERP project features. In other words, build something that meets the needs for now, but will not need to be demolished and reconstructed to meet the needs of future conditions. For purposes of comparison, the result is basically a combination of Alternative 1 (Authorized GDM Plan) and Alternative 2B (Modified GDM Plan). It has the same layout of levees and seepage canals as Alternatives 1 and 2B. It includes an initial pumping structure at the northeastern corner of the 8.5 SMA as proposed in Alternative 1. It also includes a future pumping structure located at the southern terminus of the seepage canal at the southwestern corner of the 8.5 SMA for construction after the CERP is implemented. This Alternative is shown in Figure 14.

SECTION 4.0
EVALUATION CRITERIA

4.1 PROJECT GOAL

At the request of the Governing Board of the SFWMD, the USACE has agreed to develop, evaluate and present a full array of alternatives to the plan authorized in the 1992 GDM. The desired end result of this particular planning and study effort is to facilitate potential selection of a Recommended Plan for the 8.5 SMA. The Recommended Plan must still meet the original goal of the MWD Project by providing a technical solution for the hydrological and ecological restoration of the ENP as specified in the 1989 Everglades National Park Protection and Expansion Act while providing flood mitigation to the 8.5 SMA.

In achieving this goal, each of the alternatives were evaluated relative to certain project requirements and objectives. A series of technical team meetings, made up of technical professionals from various stakeholder groups, was held to determine the criteria to be used for evaluating the alternatives. A description of the project requirements and project objectives used in this study effort is contained below.

4.2 PROJECT REQUIREMENTS

Regardless of the alternative selected, the project has certain requirements that it must accomplish in order to be considered viable. All alternatives must be designed and constructed to meet each of these requirements. The five requirements identified by the study team are:

- Do not negatively impact higher stages in ENP as specified in the MWD Project.
- Mitigate for increased stages within the 8.5 SMA resulting from implementation of the MWD Project.
- Develop a solution that can be permitted by regulatory interests under current and reasonably foreseeable regulations.
- Ensure no significant impact to existing habitat of endangered or threatened species.
- Maintain current levels of flood protection for agricultural areas east of L-31N.

The evaluation of each of the alternatives' ability to meet these requirements, and thus be considered to be feasible, is described below:

RQ1. ***Do not negatively impact higher stages in ENP as specified in the Modified Water Deliveries Project.*** To meet this requirement, it must be established that stages authorized in the MWD project can be accommodated. This is verified by evaluating water depths (stages) in NESRS for each alternative to ensure that it provides for levels in accordance with those specified in the 1992 GDM with the Authorized Plan in place. Estimated water levels will be evaluated for areas throughout the ENP property for the Authorized Plan and each of the other alternatives.

RQ2. ***Mitigate for increased stages within the 8.5 SMA resulting from implementation of the Modified Water Deliveries Project.*** The 1989 Everglades National Park Protection and Expansion Act stated that there could be no increase in flooding for any of the alternatives beyond that which existed prior to the MWD GDM. Flood mitigation, for the purposes of this analysis, is when surface water elevations due to similar climatic conditions are maintained at pre-project levels as established using the 1983 Base conditions simulations. Water depths within the 8.5 SMA at pre-MWD conditions will be compared to water depths for each alternative to verify that it meets this requirement.

RQ3. ***Develop a solution that can be permitted by regulatory interests under current and reasonably foreseeable regulations (i.e. water quality, wetlands).*** It is required that the alternatives be designed and constructed to meet regulations and permit conditions currently in effect. Potential permitting issues and requirements were identified and evaluated for each alternative in order to make sure project features are incorporated to comply with these permit conditions.

RQ4. ***Ensure no significant impact to existing habitat of endangered or threatened species.*** Another requirement of each alternative is that it must not have a significant negative impact to any known endangered or threatened species. The model grid used in the hydrologic simulation of the alternatives was evaluated to identify changes within the potential impact area. These areas are identified in the model as indicator cells. The water surface elevations within these indicator cells are evaluated and compared to existing and without project conditions and also compared to each of the alternatives.

RQ5. ***Maintain current levels of flood protection for agricultural areas east of L-31N.*** Each alternative must provide for the level of flood protection which currently exists in areas east of L-31N. Agricultural areas potentially impacted by any of the 8.5 SMA alternatives have been

identified. Water levels at indicator cells within these agricultural areas were evaluated for existing conditions and future conditions for each alternative in order to be certain that there are no significant changes in hydrology that might affect crop production.

4.3 PROJECT OBJECTIVES

Project objectives set the basis for determining if an alternative can meet the project goal. There are seven objectives of this study effort developed by the study team. The following objectives were established based on input from the multi-agency technical team:

OB1. ***Evaluate effects on hydropatterns in the NESRS.*** Hydroperiod impacts, water depths, effects on seasonal variability, and the duration of continuous flooding were measured in order to evaluate this objective.

OB2. ***Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the MWD Project.*** Potential flood mitigation and flood protection damages, and potential direct or indirect loss to local businesses, residences, and agricultural lands were determined for this objective.

OB3. ***Analyze Cost Effectiveness.*** The specific measure of cost effectiveness of the nine alternatives and two variations of an alternative considers direct project real estate costs, annual operations and maintenance costs, construction costs and local capital and annual operations and maintenance costs.

OB4. ***Analyze Effects to Ecological Functions.*** The simulation model was used to measure the spatial extent of wetlands in both the 8.5 SMA and the ENP area. Impacts to short and long hydroperiod wetland acreages were evaluated for each alternative. The functional units computed from Wetland Rapid Assessment Procedure (WRAP) were also included.

OB5. ***Evaluate effect on conditions favorable to Federal and State Listed Endangered Species survival.*** Effects to endangered species habitats were evaluated utilizing indicator cells obtained from the hydrologic simulation model.

OB6. ***Measure compatibility with CERP and C-111 Projects without adversely impacting the current level of flood protection east of L-31N.*** This objective measures the compatibility of the project with the flows and water levels resulting from the CERP features. This measure also evaluates the ability of the alternative to accommodate the C-111 project

requirements and quantifies the potential increase in water stages or duration within agricultural lands east of L-31N.

OB7. ***Analyze impacts and costs associated with time delays in implementation of alternatives.*** This objective measures each alternatives' ability to meet the December 31, 2003 implementation schedule and evaluates the impact of construction delays and administrative requirements on environmental and cultural resources.

Performance measures were developed pursuant to these objectives and are presented in Section 4.7.

4.4 MODEL SPECIFICATIONS

The model that has been selected for use in the evaluation of the alternatives for the 8.5 SMA is the MODBRANCH Model. This model is a coupling of two models developed by the USGS, MODFLOW and BRANCH. The model allows both surface and groundwater interactions that can be simulated by the coupled BRANCH and USGS modular, three-dimensional, finite difference groundwater flow (MODFLOW) models, referred to as MODBRANCH. MODFLOW simulates steady and non-steady flow in an irregularly shaped flow system in which aquifer layers can be confined, unconfined, or a combination of confined and unconfined. BRANCH simulates steady or unsteady flow in a single open channel reach (branch) or throughout a system of branches (network) connected in a dendritic or looped pattern by solving the one-dimensional equations of continuity and momentum for the river flow. Channel aquifer flows are leakage through a confining layer or riverbed. Computation of this leakage in the groundwater and surface water systems allows these processes to be coupled for simulation purposes. Specific details on the operation of the model used for this analysis are contained in Appendix A, Hydraulic and Hydrogeologic Report.

In addition to the hydrologic and geologic information typical to model input, model requirements of specific relevance to the simulation in this study include:

- Boundary Conditions
- Operating Procedures
- Precipitation
- C-111 Project Rules

These specific requirements are described in detail in Appendix A. They are summarized as follows:

4.4.1 Boundary Conditions

This represents the flow and head conditions along Tamiami Trail used in the model. There are three boundary conditions identified:

a. **Base 83.** This represents the conditions along Tamiami Trail at the time the MWD Project was authorized.

b. **Base 95.** This represents the conditions along Tamiami Trail as they exist today, based on experimental operating conditions in 1995.

c. **MWD Full Implementation (D13R)**. This represents the restored boundary conditions in the future with the MWD Project in place.

4.4.2 Operating Procedures

Rules govern the operation of the C&SF system and all of the other structures and facilities that control flow to the eastern portion of the Everglades and southern portion of Miami-Dade County. Operation of this system is modified based on many factors including climate, antecedent moisture conditions, elevations, flow and consumptive use needs. The model has developed several sets of operating procedures with a goal of accurately simulating the impact of operational changes in the region. Thus, the operating procedures represent how the entire system is operated for a specific scenario.

a. **1983 Operations.** Represents the authorized canal levels and operations prior to the Experimental Water Deliveries Program Operation.

b. **1995 Operations.** Represents operation of the system as it was operated in 1995. This also approximates the current operation of the system.

4.4.3 Precipitation

The precipitation records used for the model runs are based on actual observed rainfall data. The precipitation is one of the primary driving forces of the regional hydrology. For the purposes of model simulation, actual observed rainfall data is used as the basis for the evaluation.

a. **1989: Dry year.** The 1989 rainfall is considered to be a dry year for the purposes of this evaluation. Thus, the effects of lower than average rainfall to the system can be assessed and the impacts of each alternative quantified.

b. **1995: Wet year.** In contrast to the 1989 precipitation, 1995 is considered to be representative of a year with higher than normal precipitation. In addition, the 1995 rainfall data set used in the model simulation has been modified to include a hypothetical 1 in 10-year rainfall event. This 10-day event, introduced in week 19, allows for surcharging of the surficial aquifer levels to account for a major early season storm, and then allows the remainder of the 1995 wet year rainfall to depict actual conditions. Thus, the simulations in the model utilizing the 1995 rainfall represent hydrologic conditions expected for an above normal wet year.

4.4.4 C-111 Project Rules.

The runs for the future conditions assumed that the C-111 Project would be in place. However, as of this writing, the operational rules have not been developed or approved for this project. Therefore, a set of general assumed operating conditions were developed for the C-111 portion of the simulation model grid and held constant for all model runs with future conditions.

4.5 PROJECT CONDITIONS

Project conditions represent the existing or projected conditions for each of the simulations. They are used as a basis for comparison of various alternative scenarios. For this analysis, there were five conditions identified. They are described as follows:

CD1. ***Base 83***: This condition assumes stage and flow conditions and operations as they existed prior to the MWD Project. This is the base condition against which the federal requirement for flood mitigation must be verified.

CD2. ***Base 95***: This condition assumes stage and flow conditions and operations as they currently exist. This is the basis for which impacts of the alternatives to existing conditions will be measured.

CD3. ***Base 83 + Future Without Project***: This condition assumes that the system is operating according to the 1983 operations, the MWD Project will be implemented with C-111 in place, and the Authorized Plan (Alternative 1) will be constructed.

CD4. ***Base 95 + Future Without Project***: This condition assumes that the system is operating according to the 1995 operations, the MWD Project will be implemented with C-111 in place, and the Authorized Plan (Alternative 1) will be constructed. This is the base against which the "future with project" conditions will be compared.

CD5. ***Future With Project***: This condition assumes that the MWD Project will be implemented and the system is operating according to the 1995 operations with C-111 in place, and that any one of Alternatives 2B through 9 would be implemented.

Table 3 summarizes the features of each of the project conditions used in this analysis.

4.6 ALTERNATIVE COMPARISONS

The basis for determining the performance of the alternatives under various conditions will be evaluated using three comparisons: federal requirements, impacts to existing conditions, and comparison to the Authorized Plan.

CM1. ***Federal Requirement***: This comparison will verify that mitigation requirements are met by each of the alternatives. As defined, mitigation is achieved within the 8.5 SMA when water elevations are at or below the Base 83 condition.

CM2. ***Impacts to Existing Conditions***: This comparison will be made to determine the impacts of each alternative to current conditions (Base 95).

CM3. ***Comparison to Authorized Plan***: This comparison will be made in order to evaluate the Authorized Plan (Alternative 1) to Alternative 2B through Alternative 9 for current (Base 95) conditions.

Table 4 summarizes the comparisons used in this analysis.

4.7 PERFORMANCE MEASURES

Performance measures are quantitative or qualitative indicators of how well (or poorly) an alternative meets a specific objective. A set of performance measures was developed to use as the basis for evaluation of the various alternatives for this project. These performance measures have specific metrics related directly to each of the seven project objectives. A complete list of the performance measures and their descriptions can be found in Table 5. A general description of the performance measures is as follows:

OB1: Evaluate effects on hydropatterns in NESRS:

PM1a. **Hydroperiod Impacts**: These impacts deal with increases or decreases in hydroperiods for areas within NESRS. They are measured by the change in areal extent of increased or decreased

durations of water surface elevations above the ground surface as compared to Base 95.

PM1b. **Water Depths**: This performance measure evaluates increases or decreases in water depths for areas within NESRS. The change in areal extent of average annual increases or decreases in water depths is quantified. The evaluation consists of comparing the average annual change in water depth for each indicator cell within NESRS to the Base 95 simulation.

PM1c. **Seasonal Variability**: Effects on seasonal variability occur with a change in stage variation at key indicator cells. These effects are estimated from minimum, maximum, and absolute range of stages. The minimum and maximum stages are determined from the four-week average stages for the wet year simulation.

PM1d. **Flooding Duration:** Duration of continuous flooding performance is determined by finding the number of consecutive weeks with average weekly depths greater than 0.20-ft. at key indicator cells in NESRS.

OB2: ***Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the MWD Project:***

PM2a. **Flood Mitigation Damage**. Flood mitigation damage considers the extent of project induced change in water levels to those areas that are designated for flood mitigation not addressed by each alternative's structural features. The total numbers of acres within the 8.5 SMA has been estimated where the depth of inundation is greater than the Base 83 condition during week 26 of the wet year simulation.

PM2b. **Flood Protection Damage:** Flood protection damage evaluates the extent of project induced water elevation changes to those areas designated to receive 1 in 10-year flood protection. This will identify and quantify areas where the projected flood protection is not achieved by structural features. The total number of acres within the area to be protected has been estimated where the stage is greater than the existing ground surface elevation during week 23 of the 1995 (wet) model year.

PM2c. **Impacts to Businesses:** Potential direct or indirect loss to local business activity is considered an impact to businesses. The number of businesses impacted due to specific alternative features or performance will be determined.

PM2d. **Impacts to Residences:** The number of permanent and total residences impacted by specific alternative features or performance will be determined.

PM2e. **Impacts to Agricultural Lands:** The potential number of acres of agricultural lands, which will no longer be available for agricultural uses, is considered a loss. Additionally, the associated annual economic losses were determined for each alternative.

PM2f. **Unwilling Sellers:** Time constraints associated with the conduct of this study prevented the development of a statistically reliable survey instrument and sample survey. As a result, specific estimates of the numbers of willing and unwilling sellers for each alternative have not been developed or reported herein.

OB3: ***Analyze cost effectiveness:***

PM3a. **Project Costs:** Project costs estimated for each alternative and include capital construction costs, real estate costs and O&M costs.

PM3b. **Local Costs:** Local costs are those secondary impact costs to Miami-Dade County and/or its residents. This is measured by estimating potential capital and annual costs resulting from implementation of any alternative.

OB4: ***Analyze effects to ecological functions:***

PM4a. **Wetlands West of L-31N:** The spatial extent of wetlands west of L-31N is measured by the number of acres with a water level not less than 1.5-ft. below the ground surface with a hydroperiod of between 30 and 360 days.

PM4b. **Short Hydroperiod and Long Hydroperiod Wetlands:** A short hydroperiod wetland is characterized by Marl Prairie dominated by muhly grass and other graminoid species, characterized by inundation periods ranging from 30 to 180 days per average year. Long hydroperiod wetlands are characterized by Marl Prairie dominated by sawgrass, typically peat forming, and by inundation periods greater than 180 days per average year. Water levels typically range between 1.5-ft. below and 2-ft. above ground level.

PM4c. **WRAP Score:** A WRAP score determines the function and value of wetlands at selected indicator cells.

OB5: ***Evaluate effects on conditions favorable to Federal and State listed endangered species survival:***

PM5a. **Cape Sable Seaside Sparrow:** A Biological Assessment (BA) under the provisions of Section 7 of the Endangered Species Act (50 CFR 402), prepared by the USACE, has concluded that the project would not be likely to adversely affect any listed species. Coordination with the USFWS has been initiated and concurrence with this determination requested.

OB6: ***Measure the compatibility with CERP and C-111 projects without adversely impacting the current level of flood protection east of L-31N:***

PM6a. **Compatibility with CERP:** Compatibility with CERP is the need for project features to be removed or significantly rehabilitated to accommodate the CERP goals and features. This was measured through qualitative discussion and assessment of each alternative's ability to meet this objective.

PM6b. **Compatibility with C-111:** Compatibility with C-111 is the ability to accommodate the C-111 Project requirements. This was measured through qualitative discussion and assessment of each alternative's ability to meet this objective.

PM6c. **Agricultural Lands East of L-31N:** Agricultural lands east of L-31N are assessed by the potential increase in average annual stage at key indicator cells for the wet year simulation.

OB7: ***Analyze impacts and costs associated with time delays in implementation of alternatives:***

PM7a. **Environmental and Cultural Resources:** Environmental and cultural resources are those lost environmental resources due to higher water levels in WCA 3A, WCA 3B, and NESRS. This was measured through qualitative discussion of the resources impacted if the schedule is extended.

PM7b. **Implementation Schedule:** Ability to meet the implementation schedule will be a qualitative discussion with a statement of the expected completion date.

PM7c. **Construction Delays:** Construction delays are those unknowns associated with constructability (including land acquisition issues). This was measured through qualitative discussion of the implementation issues that will impact scheduling.

PM7d. Administrative Requirements: This includes potential delays associated with administration requirements for implementation of any potential Recommended Plan. This was measured through qualitative discussion of the administrative issues that will impact scheduling.

SECTION 5.0
ALTERNATIVES ANALYSIS

The performance of each alternative was evaluated based on requirements, objectives and performance measures as described in Section 4.0 and Table 5. An analysis of each alternative relative to the stated project evaluation criteria is included below.

5.1 ANALYSIS OF PROJECT REQUIREMENTS

Five project requirements were identified during a series of technical team meetings consisting of members of the USACE study team and representatives from various agencies and stakeholders groups. These requirements were identified as being mandatory for any alternative to be considered viable (described in Section 4.0). A description of how each requirement was evaluated and the results of the evaluation are included below. The results are also summarized in Table 6.

RQ1: Do not negatively impact higher stages in ENP as specified in the MWD Project.

The approval of the 1992 MWD GDM fulfilled the requirements of the Secretary of the Army under the 1989 Everglades National Park Protection and Expansion Act. The plan authorized by that approval and PL 101-229 included a structural flood mitigation system described in this GRR as *Alternative 1 – Authorized GDM Plan*. The results of the hydrologic analysis for Alternative 1 are contained in Appendix A and summarized in several performance measures in Section 5.2 and Table 8. The performance of this plan, in conjunction with the other components of the MWD Project, established the "goal" for hydrologic restoration in the adjacent ENP lands. As such, it is the "future without project" condition and is the basis by which the performance of all other alternatives is measured. Therefore, all other alternatives under consideration for this reevaluation (Alternatives 2B - 9) must meet, at a minimum, these stages in order to satisfy this requirement.

During the conduct of the modeling for each alternative, the water depths (i.e., groundwater stages) in ENP were evaluated as compared to those stages for Alternative 1. The relative stages were determined by examining the model results summarized in the hydrographs for the ENP and miscellaneous indicator cells presented in Appendix A (Figures 55-67). These hydrographs generally show that Alternatives 3, 6B, 6C, 6D and 8A have consistently higher weekly average groundwater stages than Alternatives 1 and 2B, with Alternative 1 having the lowest stages. These hydrographs do not include Alternatives 4, 5, 7 and 9, but it can be assumed that Alternatives 4, 5 and 7 would result in the

highest stages, while Alternative 9 would be comparable to Alternatives 1 and 2B.

In summary, all alternatives have average weekly groundwater stages that meet or exceed stages in Alternative 1, the Authorized Plan. Therefore, it is concluded that all alternatives meet Requirement 1.

In addition to the comparisons presented in the GRR, the Final Coordination Act Report (FCAR), included as Appendix G, provides hydrologic comparisons for all alternatives relative to what the FCAR has defined as full MWD implementation (i.e., the maximum potential stages in NESRS without consideration of any structural improvements for protection or mitigation of the 8.5 SMA). These comparisons were also generated from the modeling results presented in Appendix A. The differences in the interpretation and presentation of the data between the GRR and the FCAR are a direct result of the different selected basis of comparison.

RQ2: Mitigate for increased stages within the 8.5 SMA resulting from implementation of the MWD Project.

All alternatives were designed to provide, at a minimum, for flood elevation mitigation for the 8.5 SMA in accordance with PL 101-229 using structural and/or non-structural components. Flood mitigation is achieved when water depths for an alternative do not exceed those water depths within the 8.5 SMA at pre-MWD conditions (or Base 83). This comparison of water depths was conducted using the average weekly depth for week 26 during the wet year simulation. Alternatives 3 and 6B were designed to provide flood protection, above and beyond mitigation, from a 1 in 10-year flood event. Flood protection is achieved when water depths for an alternative do not exceed ground surface elevations within the 8.5 SMA. This comparison of water depth versus ground surface elevation was conducted using the average weekly depth for week 23 during the wet year simulation.

In certain structural alternatives, the design features alone could not meet the required mitigation goal of no increase in water depths. In these cases, non-structural mitigation tools such as flowage easements and land acquisition were used to supplement the structural design features of the alternative to gain full compliance with this requirement. Figures 16 to 22 illustrate the approximate extent of land acquisition and flowage easements for each of the alternatives. Additionally, Figures 119, 137, 143, 149, 155, 161, 167, and 173 in Appendix A are mitigation maps for each alternative.

Alternatives 1, 2B, 6C and 9 provide mitigation through the proposed structural features associated with each alternative. The mitigation maps included in Appendix A indicate areas within the eastern portion of the 8.5 SMA for Alternatives 1, 2B and 9 where mitigation is not achieved. However, much of the

area of increased stages are in the groundwater only and remain below ground surface elevations. For areas directly adjacent to L-31N, levels are controlled by the elevation within the canal. It is anticipated that this issue can be dealt with under an operational EIS for MWD and C-111, which is due for completion by the end of calendar year 2001.

Alternative 3 complies with this requirement through a combination of structural and non-structural means. Approximately 9% of the 8.5 SMA is provided flood protection and 18% is provided flood mitigation by structural measures. The modeling for this alternative showed that the structural features did not provide protection as anticipated due to subsurface permeability and aquifer depth (See Appendix C – Preliminary Engineering and Costs for additional details). Consequently, flowage easements for 73% or 4,693 acres of the 8.5 SMA are used to supplement the structural features and provide the required mitigation.

Alternatives 4 and 5, by definition, provide mitigation through non-structural means, including buy-out of the property and flowage easements.

Alternative 6B complies with this requirement through a combination of structural and non-structural features. The structural features provide flood protection for areas east of the proposed levee except for an area of approximately 150 acres. Flowage easements are used to provide supplemental mitigation to meet this requirement.

Alternative 6D provides flood mitigation through a combination of structural and non-structural features. The structural features for Alternative 6D provide flood mitigation for areas east of the proposed levee except for an area of approximately 546 acres. Consequently, flowage easements are used for those areas which do not receive flood mitigation by structural features.

Alternative 7 proposes the raising of roads above estimated flood stages to allow access within the 8.5 SMA. However, access alone does not meet the definition of mitigation for this project as water depths within the 8.5 SMA for this alternative are not maintained at pre-MWD conditions. Therefore, flowage easements are required to supplement this alternative to achieve full mitigation.

Alternative 8A provides mitigation by a combination of structural and non-structural measures. The structural features provide flood mitigation for areas east of the proposed flow-way except for an area of approximately 2,013 acres. Flowage easements are used to provide supplemental mitigation for this area to meet Requirement 2.

RQ3: Develop a solution that can be permitted by regulatory interests under current and reasonably foreseeable regulations (i.e., water quality, wetlands).

Regulatory and coordinating agencies participated in the formulation of alternatives since the beginning of this reevaluation study. They have provided guidance in the development of the design features of each alternative to assure that any of these plans could be implemented in compliance with applicable regulations.

The permits to be acquired would generally include a Section 404 dredge and fill permit, Environmental Resource Permit (ERP), and water quality certification. Under the Clean Water Act, as amended, an evaluation of wetlands and water quality effects, as described in Section 404 (b) (1) of this Law, must be made of any proposed discharge of materials into waters of the United States. If a net loss of wetlands is likely to occur, appropriate mitigation action should be developed and coordinated. Alternatives 1, 2B, 3, 6B, 6C, 6D, 7, 8A and 9 include structural features that would require evaluation under the Clean Water Act and could potentially require a 404 permit. Offsetting these specific and relatively minimal impacts is the reversion to more natural hydrologic conditions and historic wetlands regime throughout the Everglades system from implementation of the MWD Project. This results in a net increase in wetlands function and fish and wildlife habitat. Since the MWD Project overall is expected to result in environmental restoration with far greater positive benefits than negative impacts, separate mitigation features to offset these losses are not considered necessary.

An Environmental Resource Permit, in accordance with Chapter 373 of the Florida Statutes, will likely be required for implementation of Alternatives 1, 2B, 3, 6B, 6C, 6D, 7, 8A and 9. This permit is issued by either the SFMWD or the FDEP depending on the specific project type and location. This permit for the 8.5 SMA will likely be issued by the FDEP, particularly if construction is on SFWMD owned lands. It is anticipated that the benefit gained in the Everglades system from implementation of the MWD Project will offset any minor and local environmental concerns resulting from any of these alternatives.

Water quality was carefully considered for each of the alternatives. Alternatives 1, 2B, 3, 6B, 6C, 6D, 8A, and 9 all included interior berms to segregate the runoff from inside the 8.5 SMA so that it would not mix with cleaner seepage water from ENP. In addition, all alternatives that discharge water from a point source have design features that utilize water quality treatment impoundments or buffers.

Alternatives 1 and 9 include the collection of seepage in a canal adjacent to the perimeter levee. Flow from this canal is anticipated to be discharged into the L-31N canal for conveyance northward and eventually into the ENP near S-332. It is anticipated that the phosphorus levels in the seepage water from the 8.5 SMA

will be comprised primarily of seepage water from the ENP (Walker, 1997). Therefore, the seepage water quality will likely have phosphorus levels very close to the historic 6 ppb levels in the ENP. Thus, the discharge of seepage water into the L-31N will likely reduce the phosphorus concentrations in the canal. The water is expected to be treated in a stormwater treatment area (STA) prior to its conveyance to NESRS. The construction of this STA is a part of another Everglades restoration project and thus is not added to the cost of the projects in this report. It is postulated that the discharge of 8.5 SMA seepage water will reduce the levels of phosphorus in L-31N and thus would have a positive impact on the water quality conveyed to the STA and then into ENP.

Alternatives 2B, 6B, 6C, 6D, 8A, and 9 all consider the conveyance of water from the 8.5 SMA to the south into the C-111 Project area. All of these alternatives, except 8A, envision the construction of a seepage canal to collect water within the 8.5 SMA and maintain water level mitigation. Alternatives 2B, 6B, 6C and 9 have seepage canals that are immediately adjacent to the perimeter levee. This location means that the primary head differential across the levee to the canal is much greater than the local groundwater gradient from east to west. Thus, as has been established, the groundwater flow that is normally from west to east will continue and a preponderance of the water that enters the seepage canal will be from ENP. Alternative 6D has a seepage canal which is some distance inside the perimeter levee and thus can be expected to be influenced by the L-31N.

As noted, these alternatives discharge to the south, and into the C-111 buffer area. As indicated in the water quality analysis in the FSEIS and Appendix C, the range in phosphorus levels for this discharge to the south will be between 7 ppb and 12 ppb. Since the 12 ppb is greater than the 10 ppb discharge standard, it is assumed that treatment must occur. Best Management Practices (BMPs) can be of significant value in the reduction of pollutant loadings. One of the primary ways that BMPs can be implemented in the south Florida area is to allow for the capture and treatment both by infiltration and biological uptake. The BMP envisioned for this effort includes the construction of a treatment area in or adjacent to the C-111 Project area. This treatment area will provide water quality treatment by both biological uptake and infiltration. Additionally, sheet flow in the C-111 buffer area should aid in the enhancement of water quality.

There is no anticipated conflict with any known regulations that would affect the permitting of any of the alternatives.

RQ4: Ensure no significant impact to existing habitat of endangered or threatened species.

The USFWS is a cooperating agency with the USACE and has been an active participant in the development and evaluation of all alternatives. The FCAR from the DOI (through the NPS and USFWS) identified several species of key

concern. The FCAR identifies the locations of significant habitats and presents issues and strategies concerning the preservation and protection of these areas.

A Biological Assessment (BA) under the provisions of Section 7 of the Endangered Species Act (50 CFR 402), has been prepared by the USACE for five listed species that are known to, or might occur in the project area, including the wood stork, snail kite, eastern indigo snake, Florida panther, and Cape Sable seaside sparrow. Based on the information presented in the BA, the USACE has concluded that the project would not be likely to adversely affect any of the listed species. Coordination with the USFWS has been initiated and concurrence with this determination requested.

RQ5: Maintain current levels of flood protection for agricultural areas east of L-31 N.

All alternatives were designed to maintain flood protection in adjacent agricultural lands, located outside of the 8.5 SMA and east of L-31N. The modeling for future conditions included boundary conditions which simulate stages that will occur following completion of MWD, C-111 and CERP, which are higher than that presently existing in the area (See discussion in Appendix A).

There appear to be limited impacts to the agricultural interests east of L-31N and northeast of the 8.5 SMA. However, these impacts appear to be attributable to restoration flows to NESRS and are independent of the 8.5 SMA alternatives. This issue will be dealt with under a single Operational EIS for MWD and C-111, which is due for completion by the end of calendar year 2001.

5.2 ANALYSIS OF PROJECT OBJECTIVES AND PERFORMANCE MEASURES

Seven overall project objectives set the basis for measuring the performance of each of the alternatives. These objectives are evaluated using a series of qualitative and quantitative performance measures. Specific definition of each objective and its performance measures is included in Section 4.0, and summarized in Table 5.

The data used in analyzing all the performance measures was obtained from a variety of sources, generally included as a part of this overall document. Other sources of data included field reconnaissance, land use data from DERM, public comment and input, CERP report, and coordination with CERP and other MWD Project teams.

A system for analyzing the alternatives against each performance measure was developed for purposes of this reevaluation and is presented below. Additionally, a Fact Sheet was developed for each of the twenty-three performance measures

and serves as a summary of the detailed information presented in this Section. These fact sheets contain information regarding the source of data used in the analysis, the procedure or process by which the information was used in the evaluation, and a summary of the results. These fact sheets are included in this GRR as Table 7.

Table 8 presents the computed numeric or assigned qualitative metric for each of the performance measures. The values included in this table are absolute values (i.e., not comparison data) computed by the methodology outlined in Table 7.

For several of the qualitative performance measures, alternatives were assessed as red, yellow or green. This terminology was selected due to its recent use for presentation and evaluation purposes in CERP. A red designation generally signifies that there is significant concern that attainment of a specified objective as related to a performance measure may not be feasible. A yellow designation indicates marginal concern that attainment of the objective may be met with difficulties. A green designation signifies relative confidence in achieving the stated objectives.

Two comparison tables were prepared for further evaluation of the results of this analysis, Tables 9 and 10. Table 9 contains comparisons of all alternatives to Base 95 conditions (existing conditions). This table contains the relative difference of the performance of each alternative as compared to current conditions. It demonstrates what would be expected to change if any one of the alternatives was implemented. Table 10 compares Alternatives 2B through 9 to Alternative 1 (Authorized Plan).

The formats of Tables 9 and 10 are consistent with Tables 5 and 8, which provide a description of each of the performance measures. In total, these tables complement each other in summarizing the data compiled for all of the alternatives evaluated in this GRR.

5.2.1 OB1. *Evaluate effects on hydropatterns in the NESRS.*

The performance measures utilized for evaluation of this objective measure hydroperiod impacts, water depths, effects on seasonal variability, and the duration of continuous flooding.

Hydroperiod Impacts. The hydroperiod impacts are determined by the areal extent within NESRS where there are changes (increases and decreases) in the duration of inundation. This was computed by comparing the number of days where the water surface is above the ground for cells in NESRS for each alternative as compared to the Base 95 condition. Individual cells with an increase or decrease in the number of days were then identified and utilized to compute an area of changed hydroperiod.

The results indicate that all alternatives show an increase in areas with increased hydroperiods as compared to the Base 95 condition. The maximum difference among alternatives in spatial extent is only approximately 1,430 acres. Increases as compared to Base 95 range from a low of 24,842 acres for Alternative 2B to a high of 26,271 acres for Alternatives 3, 4, 5, 6B, 6D, 7 and 8A. Alternatives 1, 2B, 6C and 9, also show areas of decreased hydroperiods as compared to Base 95 for 1,114, 1,428, 471, and 1,271 acres, respectively, due to the location of the seepage canal.

Water Depths. The total extent of average annual increases and decreases in water depths in NESRS are quantified and evaluated for this performance measure. This was computed by comparing the average annual water depth for cells in NESRS for each alternative as compared to the Base 95 condition. Individual cells with an increase or decrease in water depths were then identified and utilized to compute the area associated with these changes.

All of the alternatives show an increase in spatial extent for increased average annual water depths as compared to Base 95 conditions. The area of increased water depths ranged from between 59,400 and 60,600 for Alternatives 1, 2B, 6C and 9 to approximately 62,000 for the other alternatives. Only Alternatives 1, 2B, 6C and 9 show a significant number of acres (ranging from 1,425 to 2,707 acres) with a decrease in water depths.

Seasonal Variability. Effects associated with seasonal variability occur with a change in stages at key indicator cells in NESRS. As a result, this performance measure includes the computation of the minimum, maximum, and range of stages. The minimum and maximum stages were determined from the 4-week sliding average stage for the wet year for each of the NESRS indicator cells, and then these stages were averaged across the indicator cells and reported for each alternative. The absolute range of stages were computed in the modeling for the indicator cells in NESRS, and then averaged and reported.

All of the alternatives show an increase for both the four-week average maximum and minimum when compared with Base 95 conditions (7.89 maximum, 5.59 minimum, 2.54 range). Alternative 3 has the highest maximum stage at 8.34-ft.. The maximum stages ranged from a low of approximately 8.05 (Alternatives 1, 2B, and 9) to a high of near 8.30 for Alternatives 3, 4, 5, 6B, 6D, 7 and 8A. The minimum stages ranged from a low of approximately 6.65 (Alternatives 1, 2B and 9) to a high of 6.95 (Alternatives 3 and 6C). There was not a significant difference in ranges for the alternatives as all were between 1.95 and 2.02.

Duration of Continuous Flooding. The duration of continuous flooding is determined by counting the number of consecutive weeks where the average weekly stage was at least 0.2-ft. above the ground surface. This was determined

for each of the selected NESRS indicator cells and then averaged and reported for each alternative.

The weeks of continuous flooding duration range from 39 weeks for Base 95 and Alternative 1 to 45 weeks for Alternatives 6B, 6D and 8A.

Summary. In summary, there are generally minor differences among alternatives for these performance measures associated with Objective No. 1. Differences, however, are observed when measuring the areas of decreased hydroperiod and decreased water depths in NESRS due to Alternatives 1, 2B, 6C and 9.

FCAR Analyses. In addition to the comparisons and results presented in the GRR, the FCAR, included as Appendix G, provides hydrologic comparisons for all alternatives relative to the MWD implementation (i.e., the maximum potential stages in NESRS without consideration of any structural improvements for the 8.5 SMA). These comparisons were also generated from the modeling results presented in Appendix A. The differences in the interpretation and presentation of the data between the GRR and the FCAR are a direct result of the different selected basis of comparison, which are Alternative 1 and full MWD implementation (without structural modifications), respectively.

5.2.2 OB2. *Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the MWD Project.*

The performance measures utilized for evaluation of this objective quantify potential flood mitigation and flood protection damages, and potential direct or indirect loss to local businesses, residences, and agricultural lands. Figures 23 to 25 summarize the results for all alternatives in relation to residence and agricultural impacts.

Flood Mitigation Damage. Flood mitigation damage considers the spatial extent of project induced increases in water levels (as compared to pre-MWD conditions) to those areas that are designated for flood mitigation and not addressed by each alternative's structural features. This comparison of water depths from each alternative to Base 83 was conducted using the average weekly depth for week 26 during the wet year simulation. Individual cells with an increase in water depths were identified and utilized to compute the area not receiving the necessary flood mitigation.

For each alternative, all properties are mitigated for increased stages within the 8.5 SMA resulting from implementation of the MWD Project as specified by Requirement No. 1. Those areas not receiving mitigation through structural features will be addressed through the use of flowage easements or by land acquisition.

Alternatives 1, 2B, 6C and 9 are considered to provide mitigation utilizing structural means without additional non-structural features. Alternatives 3, 6B, 6D, 7 and 8A require the purchase of flowage easements for approximately 4,693, 150, 546, 4,404 and 2,013 acres, respectively, to provide supplemental mitigation for increased water depths, not addressed by the structural features. This performance measure does not apply to Alternatives 4 and 5 since they are non-structural alternatives only.

Flood Protection Damage. Flood protection damage considers the spatial extent of project induced water levels exceeding the ground surface elevation to those areas designated to receive 1 in 10-year flood protection. This will identify and quantify areas where the projected flood protection is not achieved by structural features. This comparison of water depths from each alternative to the existing ground surface was conducted using the average weekly depth for week 23 during the wet year simulation. Individual cells with water surface elevations exceeding ground surface were identified and utilized to compute the area not receiving the intended flood protection. This performance measure pertains only to Alternatives 3 and 6B, which have been designated as flood protection alternatives.

Alternative 6B provides full flood protection for all but 150 acres of the designated protection area east of the proposed levee system. This area is not provided flood mitigation as compared to pre-MWD conditions, and requires the purchase of flowage easements to conform to Requirement No. 1.

Alternative 3 provides 1 in 10-year flood protection from structural features for only 9% of the 8.5 SMA. Of the remaining 91% or 5,825 acres, 1,132 acres are provided flood mitigation as compared to pre-MWD conditions and 4,693 acres or 73% need to be supplemented by non-structural measures.

Impacts to Businesses. Business activities that would be impacted either directly or indirectly from implementation of an alternative are quantified based on the business location and specific alternative features and performance.

In total, 100% or 4 businesses are impacted from Alternatives 4 and 5 due to the non-structural measures (i.e., buy-out or flowage easements) imposed for the entire 8.5 SMA. There are no impacts to businesses from any of the other alternatives.

Impacts to Residences. The number of residences impacted from implementation of an alternative is quantified based on the property location and specific alternative features and performance. Results are presented for both the total number of permanent residences to be relocated and the total number of residential structures impacted.

Results of this analysis indicate that impacts range from the relocation of a high of 208 owner occupied and 306 non-owner occupied residences for Alternative 5 to a low of 1 relocated residence for Alternatives 1, 2B, 3, 7 and 9. Alternatives 6B, 6D, and 8A impact 62%, 17% and 50%, respectively of the permanent owner occupied residences in the 8.5 SMA.

Impacts to Agricultural Lands: Agricultural lands that would no longer be available for agricultural use following implementation of an alternative are quantified based on the property location and specific alternative features and performance. The associated lost annual income was estimated and reported for all (residential and non-residential) agricultural lands impacted by an alternative.

The results of this analysis indicate that loses range from a high of 2,642 acres and $6.46 million for Alternative 5 to a low of 0 acres for Alternatives 1, 2B, 3, 4, 7, and 9. Alternatives 6B, 6C, 6D, and 8A impact 44%, 2%, 8% and 34%, respectively of the agricultural lands in the 8.5 SMA.

Unwilling Sellers. A number of informal surveys were made of homeowners and landowners within the 8.5 SMA to determine their willingness or unwillingness to sell their properties for the implementation of the alternatives, particularly the buy-out alternatives. These unscientific surveys have widely diverse results and are considered unreliable because of the uncontrolled nature of the survey instruments that would have eliminated or minimized any biased questions or responses. It is not sufficient to ask an individual about their willingness to sell their property without determining the threshold that would trigger their willingness to sell their property. This is to say that individuals may not be willing to sell their property at, for example, $1,000 per acre, but would be more than willing to sell their property at $5,000 per acre. A properly developed survey instrument would have helped identify these types of bias free data.

Time constraints associated with the conduct of this study prevented the development of a statistically reliable survey instrument and sample survey. As a result, specific estimates of the numbers of willing and unwilling sellers for each alternative have not been developed or reported herein.

Summary. In summary, the results from the flood mitigation/flood protection analyses indicate that the structural features associated with Alternatives 3 and 8A did not perform as well as anticipated. These alternatives required significant flowage easement acquisition in areas east of the proposed levee, which resulted in substantial increases in the real estate cost estimates. All other alternatives were relatively equivalent in regards to providing flood mitigation, although the means of providing mitigation was not consistent among these alternatives (i.e., structural vs. non-structural features).

Alternatives 1, 2B, 3, 7 and 9 resulted in the lowest social impacts to the 8.5 SMA as measured by impacts to residences and agricultural use. Alternatives 4 and 5

had the only impact to businesses. Specifically, these two alternatives required the location of all four of the businesses within the 8.5 SMA. Alternatives 5, 6B and 8A result in the greatest impacts to agricultural interests and residences.

5.2.3 OB3. *Analyze Cost Effectiveness.*

The performance measures utilized for evaluation of this objective estimate direct project real estate costs, project construction (capital) costs, annual O&M costs, and local capital and annual O&M costs. These costs were developed and based on professional engineering and real estate judgement and past experiences with similar projects in south Florida. Figure 26 summarizes the cost estimates for all alternatives.

Project Costs. Detailed project cost estimates are included in both Appendix C – Preliminary Engineering and Costs and Appendix D – Real Estate.

Real estate costs range from a high of $165 million for Alternative 5 to a low of $4.1 million for Alternatives 1, 2B and 9. Capital costs range from a high of $126 million for Alternative 3 to a low of $9.2 million for Alternative 4. The total initial project costs range from a high of $236 million for Alternative 3 to a low of $31 million for Alternative 1.

Local Costs. The assumptions used by USACE in determination of local costs are contained in Appendix F (Local Cost Analysis). By definition, the goal of flood mitigation for this project is to allow no increase in flooding above what existed prior to the MWD Project. It does not necessarily provide an increased level of flood protection. Only Alternative 6B provides flood protection as defined in the February 18, 2000 letter from Miami-Dade County. This alternative is expected to induce growth into the area and therefore, local costs were evaluated.

Local costs are estimated as $36 million for Alternative 6B with an annual O&M cost estimate of $900,000.

Summary. Evaluation of the performance measures associated with cost effectiveness indicates that Alternatives 1, 2B and 9 are the most economical at $31 million, $34 million and $40 million, respectively. The highest costs are associated with Alternatives 3, 5 and 6B at $236 million, $179 million and $148 million, respectively.

5.2.4 OB4. *Analyze Effects to Ecological Functions.*

The performance measures utilized for evaluation of this objective quantify short and long hydroperiod and total wetland acreages in the 8.5 SMA and NESRS. The functional units computed from the WRAP are also included as a

performance measure. Figures 27 to 29 summarize the results for all alternatives in relation to ecological function.

Wetlands west of L-31N: This performance measure quantifies the spatial extent of wetlands west of L-31N, including both the 8.5 SMA and NESRS. This is measured by the number of acres with a water level not less than 1.5-ft. below the ground surface and with a hydroperiod of between 30 and 360 days. Total wetlands are the summation of both short and long hydroperiod wetlands as further defined below.

Areas of total wetlands ranged from a low of approximately 60,000 acres for Alternative 3, to a high of approximately 62,400 acres for Alternatives 4, 5 and 7 as compared to 54,400 acres for Base 95. This represents approximately a 4% variation among alternatives.

Short Hydroperiod and Long Hydroperiod Wetlands. A short hydroperiod wetland is characterized by inundation periods ranging from 30 to 180 days per average year. Long hydroperiod wetlands are characterized by inundation periods greater than 180 days per average year. Water levels typically range between 1.5-ft. below and 2-ft. above ground level. The extent of these wetlands was generated as output from the hydrologic modeling with criteria consistent with that noted above.

All alternatives resulted in a reduction in marl forming short hydroperiod wetlands when compared to existing conditions (Base 95), suggesting an increase in hydroperiod, or possible wetland loss due to dry down associated with some structural alternatives. Reductions from Base 95 conditions ranged from a high of 5,283 acres for Alternative 3 to a low of 3,954 for Alternatives 4, 5 and 7. Long hydroperiod wetlands (peat forming) increased in acreage for each alternative when compared to existing conditions. Increases compared to Base 95 ranged from a high of 12,687 acres for Alternative 2 to a low of 10,839 acres for Alternative 3. The total variation between the alternatives (excluding Base 95) is only 3 percent.

WRAP Score. A WRAP score determines the function and value of wetlands at selected indicator cells. Appendix G – Final Coordination Act Report includes documentation for the methodology and results of the WRAP for each alternative. The results are taken directly from this Appendix.

The WRAP scores ranged from a high of 15,853 for Alternatives 4 and 5 to a low of 10,640 for Alternatives 1, 2B, and 9 as compared to 13,405 for Base 95 conditions.

Summary. The performance measures for analyzing ecological functions generally indicate that Alternatives 4, 5 and 7 provide the most benefits to the

wetlands in 8.5 SMA and NESRS. Alternatives 3, 8A and 6C result in the lowest benefits to wetlands in the 8.5 SMA and NESRS.

5.2.5 OB5. *Evaluate effect on conditions favorable to Federal and State Listed Endangered Species survival.*

A Biological Assessment (BA) under the provisions of Section 7 of the Endangered Species Act (50 CFR 402), has been prepared by the USACE for five listed species that are known to, or might occur in the project area, including the wood stork, snail kite, eastern indigo snake, Florida panther, and Cape Sable seaside sparrow. Based on the information presented in the BA, the Corps has concluded that the project would not be likely to adversely affect any of the listed species. Coordination with the USFWS has been initiated and concurrence with this determination requested.

5.2.6 OB6. *Measure compatibility with CERP and C-111 Projects without adversely impacting the current level of flood protection east of L-31N.*

The performance measures utilized for evaluation of this objective include qualitative assessments for the compatibility of each alternative with CERP goals and features and C-111 Project requirements. Another performance measure quantifies the potential impacts to agricultural lands east of L-31N due to each alternative.

Compatibility with CERP. The purpose of CERP was to reexamine the C&SF System to determine the feasibility of modifying the project to restore the south Florida ecosystem and provide for the other water-related needs of the region. Certain performance measures were established for ecological targets to determine the restoration benefits of the hydrological changes. The modeling conducted as part of CERP simulated hydrological conditions of the area using a broad scale approach. Several fundamental assumptions about operations within the C&SF System, both existing operations and future operations from projects in various stages of development, were required for the hydrologic modeling. CERP assumed that the authorized MWD Project was fully implemented, including the necessary mitigation for 8.5 SMA. The Authorized Plan or Alternative 1 was considered as the mitigation plan for the 8.5 SMA in the CERP modeling.

Alternative 1 includes a new pump station, S-357, located in the northeast corner of the 8.5 SMA at the L-31N canal. S-357 is designed to pump up to 500 cfs of seepage water from a collection canal located along a perimeter levee constructed along the western edge of the 8.5 SMA. Seepage water flows were designed to move north through the L-31N canal, to the L-29 canal and eventually back into the headwaters of NESRS. Alternative 9 also includes pump station S-357 in the northeast corner of the 8.5 SMA, similar to Alternative 1.

Alternatives 2B, 6B, 6C, 6D and 8A include pump station S-357 along the southern boundary of the 8.5 SMA. For these alternatives, the seepage flows will be delivered south into the C-111 Project area. The other alternatives Nos. 3, 4, 5 and 7 provided for flood mitigation without the construction of seepage collection systems or pumping station S-357.

All alternatives are in compliance with Requirement No. 1, which specifies that the alternatives cannot negatively impact the increased stages in NESRS as compared to full implementation of the MWD Project with Alternative 1. Compliance with this requirement also ensures that restoration levels in ENP are at least as high or higher than that included in CERP. Additionally, the model simulations used in evaluation of the various alternatives for the 8.5 SMA assumed boundary conditions consistent with CERP. As a result, all alternatives are considered to be compatible with CERP goals and objectives.

Compatibility with C-111. The 8.5 SMA lies directly north of the C-111 Project in Miami-Dade County, Florida. During alternative development several alternatives were developed that proposed discharging seepage waters through the S-357 pump station into the C-111 buffer area. The discharge to the C-111 buffer area is compatible with the overall goals of the C-111 Project. In particular, the goal of the C-111 buffer area is to provide the transition from the developed area to the east and ENP. Using this area for seepage water discharge will improve the water table elevations and thus produce a desired benefit.
It is anticipated that an Operational EIS will be completed during 2001. This Operational EIS will provide the means by which operations of the C-111 system along with all of the other restoration features can be assessed. It is expected that revised operational protocols will be a result of this EIS.

Alternatives 2B, 6B, 6C, 6D, 8A and 9 were assigned with green indicators since these alternatives discharge all or portions of the flows to the south into the C-111 buffer area. Alternative 1 was assigned a red indicator because it discharges water directly away from the C-111 project area. All other Alternatives 3, 4, 5 and 7 were assigned with yellow indicators. While not in conflict with C-111 project, they do not directly support the concept of the hydrologic buffer associated with the C-111 project.

Agricultural Lands East of L-31N. An assessment of the impact to the agricultural lands east of L-31N was determined by evaluating the change in average annual stages as compared to existing (Base 95) conditions. The average annual stages were determined for the wet year for each of the selected agricultural indicator cells, and then these stages were averaged across the indicator cells and reported for each alternative.

The average annual stages for all alternatives ranged from a low of 6.52 for Alternative 6C to a high of 6.72 for Alternative 1 as compared to 6.32 for Base 95

conditions. These results are highly influenced by boundary conditions (i.e., D13R flows and stages) and are not a direct result of the alternatives. Alternative 1, because of its pump location, will have the greatest negative impact on agricultural lands. It is planned that an Operation EIS for the conveyance and seepage system be developed. Operational protocols can be modified to mitigate for impacts.

5.2.7 OB7. *Analyze impacts and costs associated with time delays in implementation of alternatives.*

The performance measures utilized for evaluation of this objective include qualitative assessments of impacts of time delays on environmental and cultural resources, evaluation by alternative for meeting the December 31, 2003 implementation schedule, evaluation of anticipated construction delays and assessment of administrative requirements for each alternative.

Environmental and Cultural Resources. Impacts to environmental and cultural resources in WCA 3A, WCA 3B, and NESRS because of schedule delays are measured through qualitative discussions of the various impacts.

The loss of tree islands has an impact on the critical habitats and cultural resources. SFWMD staff presented rates of degradation of tree islands in WCA 3 to the Federal Working Group Panel Discussion on September 1, 1999. The total number of tree islands as well as the spatial extent of the tree islands within WCA 3 has been determined from photographs dated 1940 and 1995.

This data shows a total decrease in the number and acreage for the 55-year period as 45% and 61%, respectively. Assuming a linear relationship for the changes in tree islands, this is estimated as a loss of 8.4 islands and 246 acres per year. Delayed implementation of MWD may prolong the restoration and recovery process for the tree islands in WCA 3. Estimated values for full restoration of tree islands ranged from approximately $50,000 to $500,000 per acre.

The area of NESRS is believed to have experienced lower than historic water levels beginning in the 1960's. The lowering of the water levels would have resulted in less fluctuation in water levels and may have increased opportunity for access to the tree islands. Conversely, the Experimental Water Deliveries Program resulted in higher than normal water levels and a decrease in the ability to utilize these islands for cultural uses. It is believed, therefore, that the elimination of tree islands in WCA 3 is not directly related to the disposition of tree islands in NESRS. Thus, while access to tree island sites have occurred during the delay of implementation, permanent elimination of a site solely as a result of the delay has not been proven.

Implementation Schedule. Anticipated construction schedules for each alternative are included in Appendix C – Preliminary Engineering and Costs. Based on these preliminary schedules it is anticipated that all of the alternatives can be completed by December 31, 2003 deadline. In all cases, the land acquisition/construction activities are found to be on the critical path.

Most of the alternatives that involve facility construction have a construction time of 15 months. Land acquisition times range from 12 to 18 months depending on the alternative.

In general, the land acquisition is the first activity that commences following the initiation of the project. It is anticipated that all of the projects will commence in January 2001. Design can be initiated at the same time as the land acquisition and is estimated to take no longer than 14 months. Permitting of structural features can only be accomplished after the design has reached a 60 percent level.

Alternatives 1, 2B, and 9 were assigned with green indicators since these alternatives are or closely approximate the Authorized Plan, where implementation could proceed with current authority and agreements. Alternative 3 was assigned with a yellow indicator because of overall concerns of implementation of this alternative due to both construction issues and easement requirements. Alternatives 4, 5, 6B, 6C, 6D, 7 and 8A, which involve land acquisition or flow-way easements were assigned with red indicators due to the anticipated time requirements during the acquisition process.

Construction Delays. Construction delays are qualitatively discussed below and include land acquisition issues. The primary source of delay for construction of any of the alternatives will be the acquisition of property. USACE believes that all real estate issues can be resolved and the required properties acquired within 18 months. Additionally, site access for geotechnical exploration and surveys could impact the project schedule if this is not feasible at the start of the design process.

Alternatives 1, 2B, 6B, 6C, 6D, 7 and 9 were assigned with green indicators since the structural features included in these alternatives are typical construction activities in south Florida. Alternative 3 was assigned with a red indicator because of concerns of implementation of this alternative due to the construction of a deep seepage barrier.

Administrative Requirements. Administrative requirements and potential delays could be associated with Federal authorizations, project funding and appropriations and development or modification of a PCA with the local sponsor. As noted, the implementation schedules provided in the Engineering Appendix anticipate a project design start date of January 1, 2001. If for any reason, the start of the project is delayed, significant impacts to the implementation of the

project may occur. Design and construction may be expedited to keep the project on schedule, if necessary. However, permit submittal and review is a relatively consistent process that is difficult to accelerate.

Alternatives 1, 2B, and 9 were assigned with green indicators since these alternatives are or closely approximate the Authorized Plan, and implementation could proceed with current authority and agreements. Other Alternatives 4, 5, 6B, 6C, 6D, 7, 8A would require an amended PCA and possibility a Post Authorization Change (PAC) Report. As such, they were designated with a red indicator.

SECTION 6.0
PLAN SELECTION

This section provides a detailed comparison of the alternatives and outlines the decision process that led to selection of a Recommended Plan.

6.1 POTENTIAL ALTERNATIVES

Alternatives to mitigate the impacts to the 8.5 SMA as a result of the MWD Project have been debated and challenged beginning prior to the completion of the 1992 GDM. This issue has drawn the interest of a variety of stakeholders and interest groups, in addition to the involved State and Federal agencies, with widely differing views on the appropriate course of action. The alternatives presented in this GRR/SEIS were developed as a result of an extensive public involvement process and represent a wide range of possible mitigation and restoration actions for the 8.5 SMA.

The alternatives can be grouped into three basic categories as follows:

- Structural Plan Alternatives – These alternatives involve the construction of features along the perimeter of the 8.5 SMA, for the purpose of providing flood mitigation for the MWD Project. Alternatives 1, 2B, 3 and 9 are considered "structural alternatives." Although Alternative 7 does not involve perimeter improvements, it would also be grouped in this category because raising roads would allow the residents to remain in the 8.5 SMA.

- Non-Structural Alternatives – Alternatives 4 and 5 are considered "non-structural alternatives." These alternatives involve the acquisition of significant portions or all of the 8.5 SMA.

- Combination Alternatives – These alternatives represent a combination of land acquisition for certain areas within the 8.5 SMA and flood mitigation using structural features for other areas within the 8.5 SMA. Alternatives 6B, 6C, 6D and 8A are included in this category.

6.2 DECISION PROCESS

The decision process was based on the analysis of all performance measures for each alternative presented in Section 5.0 and Tables 8, 9 and 10 of the Final GRR/SEIS. This facilitated objective review of the data by various decision-makers and the stakeholders. This process also involved numerous public workshops to obtain input from various stakeholders and interest groups on the array of alternatives.

6.2.1 Public Comments

Input from the public played an important role in the decision-making process. Written comments were received during the formal 45-day comment period following the completion of the Draft GRR/SEIS. In addition, public workshops were held on April 26, 2000 and May 1, 2000 in Homestead, and presentations were conducted at SFWMD Governing Board meetings on April 12, 2000, May 10, 2000, and June 15, 2000. Public comment was facilitated at all of the above workshops and meetings.

The various stakeholder and interest groups expressed their differing views on the project as follows:

- Miccosukee Tribe - The Tribe supports the Authorized Plan or Alternative 1 because of its minimal cost, expeditious implementation schedule, minimal impact to the residents of the 8.5 SMA, and what they considered an acceptable level of environmental benefits to ENP and NESRS.

- Miami-Dade County – The county will be affected by any alternative that impacts future development and future local costs. County Administration expressed significant concerns relating to the potential for increased development (density) within the 8.5 SMA, and they were also concerned with incurred costs due to implementation of any alternative, equitable distribution of costs for services to its citizens, and County requirements to provide local services to the area. The County Commission is generally unwilling to support any alternative that includes condemnation of private property.

- Landowners within the 8.5 SMA - Many landowners within the 8.5 SMA expressed an opinion that Everglades restoration is not dependent on the acquisition of 8.5 SMA and did not agree with relocation as an acceptable method of flood mitigation. These residents and landowners of the 8.5 SMA are in opposition to any alternative that results in relocation or the loss of property use within their community. On the other hand, several landowners did express a desire and willingness to sell their property within the 8.5 SMA, particularly given fair compensation and relocation assistance.

- Agricultural Community - Agricultural views on this project include the concern for potential effects resulting from the flooding of farmlands, change in stage and/or regulation schedules that could impact farming operations east of L-31N, economic impacts to west and south Miami-Dade farmers, and water quality impacts.

- Environmental Groups (i.e., Sierra Club, World Wildlife Fund, Audubon, etc.) – The environmental groups overwhelmingly supported the non-structural (i.e., acquisition) alternatives such as Alternatives 4 and 5. They believe

buyout is necessary to restore hydropatterns to NESRS and ENP, to maintain water quality, and to protect existing habitats and enhance future habitats while ensuring that there is no impact to threatened and endangered species. These groups are concerned with and opposed to development in proximity to ENP.

6.2.2 Federal Partners

Federal partners involved with this project include the two DOI agencies, NPS and the USFWS. The NPS and USFWS have prepared a FCAR, which is included as Appendix G to this Final GRR/SEIS. The FCAR represents the Secretary of the Interior's report for this project.

The primary interests of these agencies are to restore hydropatterns to ENP to the extent practicable, assure that any water discharged into ENP meets water quality standards, and to protect existing habitats and enhance future habitats while ensuring that there is no impact to threatened and endangered species. These agencies are concerned with possible development within the 8.5 SMA as a result of secondary cumulative impacts of project implementation and the potential for this development to impede or reduce environmental benefits associated with MWD Project. Therefore, they prefer those alternatives that involve full or partial acquisition in order to minimize impacts to the ENP area.

Several significant issues were identified by DOI during the review of the Draft GRR/SEIS. The comparison of alternatives presented in the GRR/SEIS differs from that included in the FCAR. The DOI recommended that a consistent approach be utilized where all alternatives are compared to full MWD implementation without any structural features, as presented in the FCAR. The approach by USACE was to compare all alternatives to the without project condition (Alternative 1 in place). Other primary issues include the evaluation of water quality, compatibility with CERP and assessment of wetlands.

These agencies are critical partners in this decision-making process because of the project's proximity to ENP and the cost sharing arrangements for project implementation. Project funding was discussed in Section 2.3.2 of this GRR.

6.3 EVALUATION OF THE ALTERNATIVES

The evaluation of the alternatives is based on the performance measures and alternatives analysis presented in Section 5.0 of this GRR, as well as Section 4.0 of the FSEIS. Primary consideration was given to those objectives and performance measures associated with environmental restoration, social impacts and estimated costs. More refined hydraulic modeling and additional analytical tools by which to assess wetland function and values were used in this study that

were not available during preparation of the 1992 GDM. WRAP, a comprehensive performance measurement of wetland function, was utilized in this analysis. WRAP incorporates ecological, hydrological, and spatial variables for comparison among project alternatives. Results and discussion of WRAP evaluations are specifically presented in Appendix G of the GRR/SEIS. Social impact assessment is found in Appendix E and costs are addressed in Appendices C and F.

6.3.1 Structural Alternatives

Alternatives 1, 2B and 9 performed the best of all alternatives when evaluating project costs, flood mitigation and associated social impacts. The total estimated costs of these alternatives range from a low of $30.6 million for Alternative 1 to $39.9 million for Alternative 9. These costs are approximately 17% and 22%, respectively, of the estimated cost for Alternative 5. For these alternatives, flood mitigation would be provided throughout the 8.5 SMA, and construction features would impact only 1 residence and 0 acres of agricultural lands. These alternatives, however, generated the smallest benefit to hydropatterns in NESRS, and resulted in reduction in wetland function in NESRS and the 8.5 SMA as compared to Base 95 (existing) conditions as shown by WRAP scores of 10,640 functional units for Alternatives 1, 2B and 9 (or 79% of the WRAP functional units for existing conditions). The environmental benefits, although not as high as for Alternatives 4 and 5, do meet the overall hydrologic restoration objectives of the MWD Project as defined in the 1992 GDM.

Alternative 3 performed poorly relative to the other alternatives when evaluating project costs and environmental benefits. This alternative did not provide flood protection or flood mitigation to the 8.5 SMA as anticipated from the structural features of that alternative. Significant areas required flowage easements and, coupled with the estimated capital construction costs, resulted in the highest of all total project costs at $235.8 million, or approximately 8 times the cost for Alternative 1.

Alternative 7 provides environmental benefits relatively equivalent to Alternatives 4 and 5, although the WRAP assessment predicted 1,158 functional units less for Alternative 7. The social impacts are consistent with levels for Alternatives 1, 2B and 9, except that flowage easements are required for mitigation purposes throughout the 8.5 SMA. Total project costs are estimated as $134.6 million, approximately 75% of the cost of Alternative 5 and 4.4 times the cost of Alternative 1.

6.3.2 Non-Structural Alternatives

Alternatives 4 and 5 performed the best of all alternatives in terms of benefit to hydropatterns in NESRS and ecological function associated with wetlands in NESRS and the 8.5 SMA. These alternatives resulted in the highest WRAP score of 15,853 functional units, an 18% increase over existing conditions (13,405 functional units) and the highest total wetland acreage of 62,372, an increase of 15% over existing conditions (54,429 acres). The total wetlands are identified as short-hydroperiod and long-hydroperiod wetlands with acreages of 2,399 acres and 59,973 acres, respectively.

These alternatives, however, resulted in the highest social impacts to the 8.5 SMA (100% for Alternative 5) due to the required property acquisition and relocation of the residents and businesses (including agriculture) of that community. Additionally, Alternatives 4 and 5 were relatively expensive to implement with total costs of $132 and $179 million, respectively. There would be significantly higher social impacts and costs for Alternatives 4 and 5 in comparison to the other alternatives.

6.3.3 Combination Alternatives

These alternatives consist of a combination of structural and non-structural measures. Alternative 8A provides environmental benefits relatively equivalent to Alternatives 4 and 5, and the WRAP assessment is only 208 functional units less than maximum score of 15,853 for Alternatives 4 and 5. Alternative 8A performed poorly relative to the other alternatives when evaluating project costs and social impacts. The estimated total project cost is $153.7 million, approximately 86% of the cost of Alternative 5 and 5 times the cost of Alternative 1. This alternative did not provide flood protection or flood mitigation to the 8.5 SMA as anticipated from the structural features of that alternative. Significant areas required flowage easements in addition to the required land acquisition for implementation of the alternative, resulting in significant impacts to residences (50% of total) and agriculture (34% of total) within the 8.5 SMA.

Alternative 6B reduced the impacts to residences and agriculture within the 8.5 SMA, while maintaining a level of environmental benefits comparable to Alternative 5. This alternative would impact 62% of the total residential structures and 44% of the agricultural area as compared to 100% for Alternative 5. The WRAP score for Alternative 6B is 842 functional units less than the maximum score of 15,853 associated with Alternatives 4 and 5. Total project costs are estimated at $147.7 million, approximately 83% of the cost of Alternative 5 and 4.8 times the cost of Alternative 1.

After reviewing the results for Alternative 6B and considering public input, Alternative 6C was developed as a variation to try to further minimize social

impacts and project costs while maximizing the environmental benefits. Alternative 6C would impact 8% of the total residential structures and 2% of agricultural areas as compared to 62% and 44%, respectively, for Alternative 6B. Total project costs were reduced and are estimated at $62.8 million, approximately 35% of the cost of Alternative 5 and 43% of the cost of Alternative 6B. The environmental benefits associated with Alternative 6C were generally less than the benefits associated with Alternative 6B. The WRAP score, for example, for Alternative 6C is 4,253 functional units less than the maximum score associated with Alternatives 4 and 5 and 3,411 less than Alternative 6B.

After reviewing the results for Alternatives 6B and 6C, and again considering public input, Alternative D was developed as a variation to try to minimize social impacts and project costs while optimizing the environmental benefits. Alternative 6D would impact 17% of the total residential structures and 8% of agricultural areas as compared to 62% and 44%, respectively for Alternative 6B and 8% and 2%, respectively for Alternative 6C. Total project costs for Alternative 6D are estimated as $88.1 million, approximately 60% of the cost of Alternative 6B, 1.4 times the cost of Alternative 6C and 2.9 times the cost of Alternative 1. The environmental benefits associated with Alternative 6D increased as compared to Alternative 6C and were generally consistent with the level of benefits for Alternatives 6B and 5. The WRAP score, for example, for Alternative 6D is 1,126 functional units less that the maximum score associated with Alternatives 4 and 5 and 3,127 greater than Alternative 6C.

6.3.4 Summary Evaluation

The environmental benefits and impacts for each alternative are quantified by hydropattern effects in NESRS (Objective 1) and effects to ecological functions (Objective 4) as further summarized below for each of the three groups of alternatives:

Objective 1.	Evaluate Effects on Hydropatterns in NESRS.											
		Structural					Non-Structural		Combination			
Measure	Units	Alt 1	Alt 2B	Alt 9	Alt 3	Alt 7	Alt. 4	Alt. 5	Alt 6B	Alt 6C	Alt 6D	Alt 8A
a. Hydroperiod Impacts[1]	Increased Hydroperiod (ac)	24,999 (avg)			26,271		26,271		26,271	25,799	26,271	
	Decreased Hydroperiod (ac)	1,271 (avg)			0		0		0	471	0	
b. Water depths[1]	Increased depth (ac)	59,469 (avg)			62,261 (avg)		62,125		62,068	60,643	62,049 (avg)	
	Decreased depth (ac)	2,598 (avg)			0		0		0	1,425	0	95
[1] Value represents the comparison of each alternative versus the Base 95 Condition												

Objective 4.	Analyze Effects to Ecological Functions												
			Structural					Non-Structural		Combination			
Measure	Units	Base 95	Alt 1	Alt 2B	Alt 9	Alt 3	Alt 7	Alt. 4	Alt. 5	Alt 6B	Alt 6C	Alt 6D	Alt 8A
a. Wetlands west of L-31N	area (ac)	54,429	61,820 (avg)			59,985	62,372	62,372		61,543	61,117	61,893	60,902
b. Short-Hydroperiod Marl Forming Wetlands	area (ac)	6,353	1,470 (avg)			1,070	2,399	2,399		2,074	1,290	2,055	1,908
c. Long-Hydroperiod Peat Forming wetlands	area (ac)	48,076	60,350 (avg)			58,915	59,973	59,973		59,469	59,827	59,838	58,994
d. WRAP Score	Functional Units	13,405	10,640			11,630	14,695	15,853		15,011	11,600	14,727	15,645

Alternatives 4 and 5 resulted in the highest environmental benefits when considering these factors. However, Alternative 6D resulted in similar environmental benefits at significantly less cost. Alternative 6D provides 93% of the maximum wetland functional value, which would be derived from Alternative 5 at 49% of the cost.

Alternative 6D minimized social impacts as compared to Alternative 5 while maintaining a level of environmental benefits which approaches (93%) the level of benefits (in terms of wetland function) produced by Alternative 5.

Additional graphics comparing the alternatives using the performance measures associated with environmental benefits, costs and social impacts are included as Figures 23-29.

6.4 PLAN SELECTION PROCESS

6.4.1 General

The Federal objective of this study is the same as for the 1992 GDM, i.e., restore hydropatterns in NESRS to the extent practicable while mitigating for adverse impacts to the 8.5 SMA. Consistent with this objective, the Recommended Plan must be cost-effective and maximize ecosystem benefits to the extent practicable. Because a technical solution was approved and authorized by the 1992 GDM (Alternative 1), it became the baseline comparison for this study and was identified as the without project condition. The need to reevaluate this plan can be attributed to enhanced modeling capabilities and an expanded scientific understanding of the ecosystem function and structure that was not available during the preparation of the 1992 GDM.

Selection of the Recommended Plan is based on the criteria provided in the Principles and Guidelines (ER 1115-2-100) in two parts: The Economic and Environmental Principles for Water and Related Land Resources Implementation Studies and The Economic and Environmental Guidelines for Water and Related Land Resources Implementation Studies. The criteria are completeness, effectiveness, efficiency and acceptability. All of the alternatives were fully developed as complete and effective solutions to the Federal objective. Of the

remaining criteria, the efficiency and acceptability are the two that will facilitate the decision making for mitigating adverse impacts.

6.4.2 Screening of Alternatives

As a first step in the evaluation process, an alternative was chosen that was the clearly the best performer among the three different categories of alternatives. Reference can be made to the more specific evaluation found Section 6.3 above.

1. Structural Alternatives: (1, 2B, 3, 7 and 9): Alternative 1 continues to represent the best structural solution to mitigating the increased stages in the 8.5 SMA. It meets the ecological goals of the MWD Project while minimizing project costs and social impacts. Alternative 3 was by far the most expensive alternative and the worst ecological performer in this group. Alternatives 2B and 9 did not provide additional functional units beyond Alternative 1, were both higher in costs and do not compare well to Alternative 1. Alternative 7 was the best of the structural alternatives in terms of meeting environmental restoration goals but the costs were significantly, higher (4.4 times) than Alternative 1.

2. Non-Structural Alternatives (Alternatives 4 and 5): Alternative 5 represents the best non-structural alternative since it will restore the entire 8.5 SMA to a more natural environment and remove all present and future impediments to rehydrating the ENP. Of all alternatives, Alternative 5 maximizes the environmental and ecological benefits to ENP and NESRS. Although Alternative 4 is lower in cost, this is offset by several negatives: (a) the potential for continued development; (b) probable increased litigation by residents due to ambiguities in determining what constitutes the difference in flooding with and without the project; and (c) continued water quality problems due to anthropogenic activities.

3. Combination Alternatives (6B, 6C, 6D and 8A): Alternative 6D represents the best combination alternative since it optimizes environmental benefits while balancing social impacts and project costs. Although Alternative 8A resulted in the most functional units, it did so at the highest cost of all the combination alternatives. For Alternative 6B and its associated variations (Alternatives 6C and 6D), adjustments in the perimeter levee location directly impacted WRAP functional units, social impacts, and project costs. As the levee shifted west from its location in Alternative 6B, the environmental benefits (i.e. WRAP functional units), social impacts, and project costs were reduced.

6.4.3 Evaluation of Alternatives

Alternative 1 represents the best structural plan that has the least social impacts. Alternative 5 is the best non-structural plan that maximizes ecosystem restoration. Alternative 6D is the best combination plan with balanced results. The evaluation will continue with these three alternatives as follow:

1. Functional Units (WRAP): Compared to Alternative 1, Alternative 6D is the most cost effective of all the alternatives in terms of increased functional units of wetlands, providing 4,087 functional units more than Alternative 1 at a cost of $14,069 per unit. Alternative 5 had the highest output of additional functional units, but had a significantly higher cost per functional unit at $28,467 per unit. Alternative 6D provides nearly 93% of the functional units provided by Alternative 5 at approximately 49% of the cost. Figure 40 shows the incremental cost per WRAP functional unit as compared to Alternative 1.

2. Endangered species benefit: Alternative 5 provides the best optimal mix of suitable wood stork habitat during water level recession. Per USFWS analysis, Alternative 6D provides a similar mix while Alternative 1 has a lesser mix. Alternative 6D provides an increase of 2,731 acres of snail kite habitat over Alternative 1. This amount is 70% of that provided by Alternative 5 at approximately 49% of the cost.

3. Short-Hydroperiod Wetlands: Alternative 6D increased the area of short-hydroperiod wetlands by 365 acres over Alternative 1. Alternative 5 provides an additional 344 acres, but at a significantly higher incremental cost of $90.9 million.

4. Increased Water Depths: Alternative 6D provides for an additional 2,708 acres inside NESRS with increased water depths above Alternative 1. This is essentially the same acreage as Alternative 5 (2,765 acres) but they are provided at a substantially reduced incremental cost ($90.9 million dollars less than Alternative 5).

5. Lengthened hydroperiods: When compared to Alternative 1, Alternative 6D increases the area with a lengthened hydroperiod by an estimated 1,115 acres in NESRS. This is equivalent to the increase achieved by Alternative 5, but at a substantially reduced incremental cost ($90.9 million less than Alternative 5).

6. While displacing an additional 34 households over and above that of Alternative 1, Alternative 6D impacts less than 17% of the total number of households that would need to be relocated with the implementation of Alternative 5. Thus, over 83% of the owner-occupied and non-owner occupied residences would not be affected with the implementation of

Alternative 6D, thereby preserving, to a large degree, the culture, heritage, community cohesion and sense of place that presently exist within the area. Although relocation of 34 households will be required, this alternative will generate environmental benefits comparable to that of Alternative 5 at significantly less social impacts.

7. Similarly, Alternative 6D removes about 215 acres of agricultural land from production along the income producing capability associated with these lands over and above that of Alternative 1. These lands represent about 8 percent of agricultural land that would be removed from production with the implementation of Alternative 5. Therefore, about 92 percent of the agricultural productivity and income producing potential of the 8.5 SMA will be preserved with implementation of Alternative 6D over Alternative 5.

6.4.4 Results

The 8.5 SMA is part of an ecosystem restoration project and benefits are non-monetary. Alternative 6D is the plan that reasonably maximizes ecosystem restoration benefits compared to costs and is identified as the National Ecosystem Restoration Plan. The results of the evaluation process outlined above demonstrate that the Authorized Plan does not maximize ecosystem restoration benefits as well as Alternative 6D. This result can be attributed to enhanced modeling capabilities and an expanded scientific understanding of ecosystem function and structure that was not available during preparation of the 1992 GDM. Figure 40 illustrates how WRAP outputs have helped quantify the efficiency criteria used in evaluation of alternatives. Alternative 6D provides a significant increase in the environmental benefits compared to Alternative 1, at a cost of $14,069 per functional unit.

Alternative 6D strikes the best balance between those alternatives that heavily favor the environment (Alternative 5) and those with the least impact to landowners (Alternative 1). In recognition of this fact, the local sponsor, SFWMD, recommended this plan for adoption by the Federal Government. The plan costs approximately $60 million more than the Authorized Plan, but the environmental benefits (detailed in 6.4.3 above) are substantial and justified. The additional costs are due to acquisition of close to 45% of land interests (36% in fee) in the 8.5 SMA. Because there is still vacant land available within the remaining 55%, the unique character of the community can be maintained. Alternative 6D impacts less than 17% of the total households that would need to be relocated under Alternative 5, and removes only 8 percent of agricultural land from production. Some additional environmental benefits will result in the reduced potential for adverse secondary environmental impacts relative to development within the western portion of the 8.5 SMA and adjacent to ENP.

After carefully weighing all relevant data including public input, it has been determined that Alternative 6D (with certain conditions) is the Recommended Plan. It is consistent with the Federal objective, reasonably maximizes ecosystem restoration benefits compared to costs and social impacts and is the National Ecosystem Restoration Plan for this project.

SECTION 7.0
DESCRIPTION OF RECOMMENDED PLAN

This section provides a description of the preliminary design of the Recommended Plan. The changes and differences of the Recommended Plan compared to the Authorized Plan (Alternative 1) are summarized in Table 15.

7.1 RECOMMENDED PLAN DESCRIPTION

The Recommended Plan consists of perimeter and interior levees as well as a seepage canal that will be constructed as shown on Figure 39. The location of the perimeter levee is generally east of the Phase 1 - SOR boundary line. The perimeter levee on the western boundary of the Recommended Plan ranges from approximately 0.10 to 1.05 miles east of the westernmost boundary of the 8.5 SMA, depending on the location along the boundary. The perimeter levee runs west from L-31N at the northeast corner of the 8.5 SMA, just inside the limits of the 8.5 SMA to 197th Avenue, then south to 120th Street, west to 204th Avenue, south to 130th Street, west to 208th Avenue, south to 148th Street, west to 213th Avenue, and south where it terminates at 168th Street (Richmond Drive). This Recommended Plan includes approximately 4.5 square miles of land within the perimeter levee (approximately 45% of the 8.5 SMA).

The seepage canal system and interior levees run along 205th Avenue north from 168th Street to 132nd Street, then east along 132nd Street to the L-31N canal. The seepage collection canal is designed to maintain the groundwater levels within the area interior of the outer levee at the same levels as existed prior to the implementation of the MWD Project.

Two interior levees, one on either side of the seepage canal, are positioned to prevent surface water from directly entering the seepage canal. A new proposed pumping structure (S-357) located at the southern terminus of the levee/canal system, will discharge seepage water south into the C-111 Project area.

All lands within the 8.5 SMA west and north of the perimeter levee will be acquired. All residences, structures, and roads shall be removed from within the area west and north of the perimeter levee. (Residences, structures, and road removal within the ENP Expansion Area will be covered under other studies associated with the MWD Project. This project requirement will only apply to the 8.5 SMA).

All lands acquired to implement the Recommended Plan shall become part of the Federal project and shall be managed by the SFWMD in accordance with a jointly developed management plan consistent with the purposes of the MWD Project. Lands shall be appropriately managed to maximize ecological function

and structure, restore hydrologic conditions, effectively control invasive exotic species, incorporate fish and wildlife enhancement features, and maintain wetland function.

The Recommended Plan shall include adequate water quality treatment features necessary to meet all applicable water quality standards and applicable permitting requirements at the time of implementation.

Since water from the seepage canal is discharged to the area of the C-111 Project, the USACE shall complete necessary construction prior to initiating any discharges from the Recommended Plan. The USACE shall also provide sufficient information to technically demonstrate that the C-111 Project footprint will provide sufficient capacity as well as adequate water quality treatment prior to initiating any discharges.

The final design, construction and operation of the Recommended Plan shall provide for flood mitigation, not flood protection, for the areas east of the perimeter levee. Mitigation, for purposes of this Plan, is defined as preventing increases in water levels due to the implementation of the MWD Project (above the 1983 Base condition) within that portion of the project area bounded by the perimeter levee.

7.2 BASIC DESIGN OBJECTIVES AND CRITERIA

The design of the Recommended Plan will be further evaluated, refined and optimized during final design and the preparation of detailed engineering plans and specifications. Certain comments received on the Draft GRR/SEIS were of a very technical nature. Those comments are valid and directly applicable to the next step in this process, which is detailed engineering design.

The hydrological benefits to NESRS and ENP, as defined in this GRR/SEIS for Alternative 6D, will serve as the minimum acceptable restoration goals during final design. Any significant design changes will be evaluated to assess their impact to these hydrological parameters. Changes that have a negative impact to hydropatterns in NESRS will be revised to eliminate this impact or will not be incorporated into the final design.

The levee and canal alignment will be further evaluated and optimized during final design. This alignment will maximize the extent of wetlands to the west and minimize impacts to residents of the 8.5 SMA to the extent practicable, but avoiding impact to the hydrologic restoration of NESRS as defined in this GRR/SEIS for Alternative 6D.

Fish and wildlife enhancement features were outlined in the FCAR, included as Appendix G. Specific enhancement features include nesting islands and upland

refugia habitat, fish refugia habitat, littoral shelves, foraging sloughs and vegetative buffer zones. The objectives of these features are to maximize the spatial extent of short-hydroperiod wetlands, maximize structural diversity for fish and wildlife resources and maximize opportunities to enhance water quality. During final design, the USACE will work closely with USFWS to evaluate and incorporate these enhancement features where appropriate.

7.3 ENGINEERING DESIGN

Preliminary engineering design for the Recommended Plan includes the following:

- Foundation materials
- Geotechnical Design Parameters
- Perimeter Levee
- Interior Levees
- Seepage Canal
- Bridges
- Pump Station and Pipeline
- Treatment Area

Preliminary geotechnical engineering design of these structures was based on information presented in the 1992 GDM. Additional information was obtained from the Soil Survey of Dade County Area, Florida (1996). A geotechnical site characterization investigation will be performed as part of the final engineering design.

7.3.1 Foundation Materials

The information presented in Appendix G of the 1992 GDM indicates the area to the north and northeast of the 8.5 SMA area may be underlain by 2 to 4-ft. of peat underlain by a thin layer of silt. Beneath the peat and silt is solution riddled limestone that may contain cavities. The peat/silt material is highly compressible and relatively weak. The limestone material is highly permeable; however, the material is relatively strong and is capable of supporting levees, the pump station and bridges.

It appears the 8.5 SMA is underlain by similar materials; however, the silt and peat layer appear to be less than 1-foot in thickness. This thin layer of compressible material is expected to pose no problems for either the construction or stability of the levee and will not adversely impact foundation design for the pump station and bridges because of its relatively shallow depth. Additionally, the Soil Survey of Dade County Area, Florida (1996) indicates that marl or limestone rock is exposed at or near the ground surface along the western and northern perimeter of the 8.5 SMA. Medium hard to hard highly permeable limestone rock is expected to be encountered from the ground surface to below the canal invert elevation (depth of 15-ft.) for the entire 8.5 SMA.

7.3.2 Preliminary Geotechnical Design Parameters

The levees will be constructed from crushed processed rock obtained from the canal excavation. The levees, pump station, and bridges will be supported on the relatively strong limestone material. Preliminary geotechnical design values are presented below. These values are based on information presented in the 1992 GDM and correlations presented in USACE Engineer Manual EM 1110-2-1913, Engineering and Design and Construction of Levees. Laboratory testing will be performed during the geotechnical investigation for final design to determine the engineering characteristics of these materials necessary to perform stability, seepage, and settlement analyses.

Stratum	Depth (ft.)	Moist Density γ_m (pcf)	Cohesion c´ (tsf)	Internal Friction ϕ´ (degrees)	Permeability Coefficient	
					k_v (ft/day)	k_h (ft/day)
Levee Fill	-	120	0	32	285	285
Limestone	0 to 50	125	0	35	21600	21600

7.3.3 Perimeter Levee

The perimeter levee has an estimated length of 34,500-ft., a top width of 20-ft. and a crown elevation of 10.2-ft. The location of the levee is shown on Figure 31. The distance between the perimeter levee and the seepage canal varies from 0.1 to 1.05 miles (500 to 5,500-ft.). As shown on Figure 31, the perimeter levee includes a geomembrane on the upstream (ENP) side of the levee to increase the seepage path and thus reduce seepage into the area between the perimeter levee and the seepage canal. A woven geotextile will be placed beneath the levee to stop migration of embankment fill into the porous limestone and to distribute the embankment load if localized peat/muck deposits are encountered.

The levees will be constructed from crushed processed rock obtained from the canal excavation. Approximately 347,800 cubic yards are required for construction of the perimeter levee. The fill material will have a maximum particle size of 2 inches with less than 10% material by weight passing the No. 200 sieve. All fill material will be compacted to a minimum density of 95% of the standard Proctor dry density.

Based on the geotechnical parameters presented in the above table, the calculated factor of safety for the perimeter levee exceeds a value 1.5; this is considered to be the minimum acceptable value for levee operational conditions.

The calculated seepage beneath the levee is very sensitive to the hydraulic conductivity value for the limestone. The pump test data included in Appendix G, Geotechnical Investigation, of the 1992 GDM indicates considerable variability in the hydraulic conductivity (transmissivity) values for the limestone in this area. A value of 21,600-ft. per day (fpd) was selected for the preliminary seepage analyses; this is equivalent to 0.25-ft. per second (fps). Pump tests will be performed during the detailed site characterization investigation to obtain a better estimate of the transmissivity of the limestone materials along the levees and seepage canal. Preliminary seepage calculations indicate that approximately 680 cubic ft. per day (cfd) of water seeps beneath the perimeter levee for each linear foot of levee. The results of the preliminary seepage analysis are shown on Figure 32.

The levee settlement is not a concern provided that the peat/silty clay layer above the limestone is less than 2 to 4-ft. in thickness. Test pits will be performed to evaluate the thickness and areal distribution of the surficial peat/silty clay layer. This data will be used to complete the design of the perimeter levee. Localized areas with a thicker surficial peat/silty clay layer may require the use of a heavier woven geotextile to distribute the weight of the levee fill, and may require the top of levee elevation be raised to allow for future secondary settlement of this compressible material.

7.3.4 Interior Levees

Interior levees will be constructed on both sides of the canal as shown on Figure 33. The top of levee will be at EL 9.5-ft. and the levee will have side slopes inclined at 3:1 (horizontal to vertical). Each interior levee is approximately 20,800-ft. in length. A fill volume of about 110,800 cy is required for both. The interior levees will also be constructed from crushed processed rock obtained from the channel excavation. The top of levees will be 12-ft. wide to allow access for maintenance and repair. The width and or height of the levees could be increased if it costs less for the contractor to crush, process, and place the

canal excavation material instead of hauling the material off-site. This option will be included in the final project plans and specifications.

7.3.5 Seepage Canal

The seepage canal is designed for the flow rates calculated by the USACE using the MODBRANCH model. Based on the results of the USACE analyses, a total flow rate of 500 cfs is anticipated at the terminus of the seepage canal at SW 168th Street. This flow rate can be equally distributed along the 20,800-ft. of canal to allow sizing of the canal cross-sections for each segment shown on Figure 33. The calculated canal sections are shown in Table 16. A canal bottom slope of 0.000024 ft/ft was used to calculate the canal flow rate; this is an average gradient of 0.50-ft. over the canal length. The estimated excavation volume, assuming a 20% overcut, would be 540,000 cy.

The seepage canal will be formed by drilling, blasting and excavating the limestone rock. Drilling and blasting shallow rock typically results in an irregular surface. The finished side slopes may vary from the design value of 1:1 and the bottom may also be irregular. However, the project specifications will state that the canal dimensions shown on the plan are a minimum and overcut will likely occur during construction. The preliminary cost estimate includes the 20% overcut allowance.

The blasting and excavation should reduce the limestone rock to a graded cobble, gravel and sand mixture. The excavated material should be suitable for the levee construction provided the material is crushed and processed; the maximum particle size of the crushed rock should be less than 2 inches.

The seepage canal shown on Figure 33 varies in depth from 12.5 to 15-ft. and the bottom width varies from 25 to 30-ft. with side slopes of 1:1. Section A1-E1 is 12.5-ft. deep and has a bottom width of 25-ft. and starts at canal L-31N and proceeds west along the southern boundary of the FAA property for a distance of 9,100-ft. Section E1-I1 of the canal then turns south and proceeds for a distance of 11,700-ft. to the terminus at the S-357 pump station located north of Richmond Drive (168th Street). This section of the canal is 15-ft. deep with a bottom width of 30-ft.

7.3.6 Bridges

Three bridges will be required for the Recommended Plan to connect the area between the perimeter levee and the seepage canal with the eastern portion of the 8.5 SMA. As shown on Figure 30, the bridges will be located at 197th Avenue, 136th Street, and 152nd Street. The bridges will be designed according to Florida Department of Transportation design standards and will be designed

for HS-20 truck loads. The bridges will be single span with deck lengths of 70 to 75-ft. The abutments will be supported on spread foundations bearing on the limestone; deep foundations are not required.

The bridge at 197th Avenue, shown on Figure 34, will have a deck length of 70-ft. to span the seepage canal that has a bottom width of 25-ft. and a top width of 50-ft. The deck will be set at an elevation of 12.5-ft.; however, this elevation could vary depending on the elevation of the bottom of the bridge girders. The bridge girders will be set a minimum of 1-foot above the top of the existing ground surface elevation. Approach roadways will be required to transition from the existing ground surface EL 6.5-ft. to the bridge deck EL 12.5. The approach roadway will be constructed at a grade of approximately 5% with crushed processed fill from the canal excavation to transition from the bridge deck elevation to the top of the internal levee. Beyond the internal levee the roadway will be constructed at a grade of 5% to the existing ground surface elevation. The approach roadway will be constructed of properly compacted fill without a roadway surfacing.

The bridges at 136th Street and 152nd Street, shown on Figure 35, will cross canal section E1-I1 where the bottom canal width is 30-ft., the top width is 60-ft., and the canal depth is 15-ft. These bridges will have a deck length of 75-ft.. The bridge deck will be set at approximately EL 12.5-ft.; however, the deck elevation will be determined during final design. The approach roadways will be similar to the roadways for the bridge at 197th Avenue.

7.3.7 Pump Station and Pipeline

A pump station, S-357, is required to lift the seepage water from the southern terminus of the seepage canal to convey it to the treatment area. The new station will be constructed approximately 200-ft. north of 168th Street (Richmond) as shown on Figure 30. The station will be designed for a capacity of 500 cfs. Three vertical axial flow pumps will be provided, each rated for 250 cfs at a design head of 11.5 ft. The station will be designed so that two of the three pumps will operate to deliver the 500 cfs. The pumps will be electric driven, and a diesel-powered stand by generator will be provided to operate two of the pumps plus ancillary equipment in the event of a power failure.

The station will be approximately 50-ft. by 100-ft. in plan with a finish floor elevation of 10.0-ft. The seepage canal will transition to a 50 foot width at the station and its bottom elevation will drop 1 foot to EL 9.5-ft. The station will discharge to an open head tank on the south. Flow will exit the head tank through a 96-inch reinforced concrete pipe for conveyance to the treatment area approximately 2,000-ft. to the south. A pipe is required because the water level in the treatment area will be higher than existing ground at the pump station.

Rubber gasket joints will be used on the pipe. A preliminary plan for the pump station is shown in Figure 36.

7.3.8 Treatment Area

The treatment area will be approximately 3000 ft by 3000 ft. A 5 ft high perimeter berm will be constructed with a 12 ft crest width and 3:1 side slopes. The maximum water surface inside the treatment area will be 4 ft. An inlet structure and berm will be constructed to transition the flow from the pipe and distribute it along the north end of the treatment area. Baffles may be included in the design as warranted.

The treatment area will be located in the C-111 project area, for which the majority of the lands have been acquired. Its exact location and design will be coordinated with that project. It is anticipated that this treatment area, a C-111 project feature, will be in place prior to completion of the 8.5 SMA mitigation project. However, capital costs for the treatment area have been included in this project to ensure that it can be constructed independent of the C-111 project if necessary.

7.4 DEMOLITION

The Recommended Plan also calls for the creation of open space west of the perimeter levee. The creation of open space is necessitated due to the periodic inundation of the area that will result from the increase of surface water elevations within ENP. Thus, those private lands generally to the west of the perimeter levee would become public lands under this alternative. With the purchase of the property, the question of what becomes of the land then becomes a concern. Historically, the area on the eastern portion of the 8.5 SMA has been found suitable for agriculture usage. The area to the west, closer to ENP, is primarily open land with some limited residential use. The Recommended Plan provides flood mitigation to the portion of land east of the perimeter levee. Therefore, it is expected that this land will be developed in accordance to the estimates in the Social Impact Assessment and Local Cost Analysis identified as Appendices E and F, respectively. The western portion of the area will be subject to increased surface water elevations and extended periods of inundation.

Purchases by SFWMD, through the SOR program, have transferred some properties from private to public ownership. For the most part, structures that existed on the property have been razed and the demolition debris removed and disposed. Most of these sites have raised areas where the former structure pads and access roads were located.

Three basic options for demolition of existing structures have been proposed. These include:

A. Demolition of current structure without removal of fill pad. This option for demolition is similar in nature to what the SFWMD is currently doing with lands that it has purchased within the 8.5 SMA. The structure is razed but the fill pad and access road are left intact. Septic systems are collapsed and filled.

B. Demolition of current structure, removal of fill pad and access road. This option provides for the demolition of the current structure including the removal of the fill pad, access road, and septic system. Property is regraded to approach natural (pre-development) conditions. Natural recruitment is expected to foster wetland growth.

C. Demolition of current structure, removal of fill pad, access road, exotics removal and land management. This option provides for the demolition of the current structure including the removal of the fill pad, access road, and septic system. Property is regraded to approach natural (pre-development) conditions. Exotic species are removed from the site and the area is managed to promote natural wetland development.

As can be seen by the three optional procedures for land management presented above, the level of effort can range from the minimal clearing of the site (option A) through full site management (option C).

For the purposes of this evaluation, demolition north and west of the perimeter levee would be consistent with option C, as described above, and would require both structure removal and land management. The SFWMD will manage the area that is allowed to migrate to wetland conditions. The design will include not only demolition and disposal, but will also provide for the management of the property for the project life.

Septic systems can either be completely removed and disposed, or can be pumped, crushed and abandoned in place. These will be handled on a case-by-case basis depending on site conditions and potential for adverse environmental impacts.

7.5 CONSTRUCTION PLAN

The construction plan for the Recommended Plan differs from Alternative 1 because the perimeter levee is separate from the interior levees and seepage canal. This separation distance of 0.1 to 1.05 miles complicates the construction operation because the fill for the perimeter levee will need to be hauled by truck from the seepage canal excavation. The haul distance will affect construction

costs. From a construction viewpoint, it is preferred to haul the material over the existing 8.5 SMA roads.

7.5.1 Canal Excavation

After clearing and grubbing the construction site, the basic construction sequence will consist of drilling, blasting and excavating the seepage canal in accordance with the canal dimensions presented in Table 16. It is anticipated that the excavated canal surface will be relatively rough from the blasting/excavation process. The excavated material will be comprised of a graded material consisting of sand to rock size particles; relatively large pieces of rock may be generated by the blasting operation because of the relatively shallow blasting and variable limestone hardness. A crusher will be required to process the blast rock to produce the levee fill material. The rock should be crushed to a maximum particle size of 2 inches.

The blasting operation will produce transient vibrations that will attenuate with increased distance from the blast location. The vibrations produced by blasting should be barely perceptible to humans at a distance of approximately 1-mile and distinctly perceptible at a distance of ¼ to ½ mile. For structures located within a distance of ¼ mile of the blasting operations, vibration levels should be measured, and shot charges may need to be adjusted to maintain a vibration level below a peak particle velocity of 0.5 inches per second. As part of the final design, the distance of structures from the seepage canal will be determined and a plan for a pre-construction survey and vibration measurements will be developed.

7.5.2 Levee Construction

The canal blast rock is suitable as fill for levee construction. This material can be excavated with conventional excavating equipment. A crusher will be required to reduce the limestone rock to sand-gravel gradation with maximum particle size less than 2 inches. The crusher will likely be moved as the canal excavation progresses to reduce the handling of the canal blast rock material.

The perimeter levee construction will consist of the following general construction sequence:

(1) Place woven geotextile beneath levee embankment.

(2) Construct core of perimeter levee.

(3) Shape levee surface.

(4) Place non-woven geotextile “cushion” on upstream 3:1 (H:V) face of perimeter levee in areas where geomembrane will be placed.

(5) Place non-woven geotextile above geomembrane to protect geomembrane from puncture.

(6) Complete construction of perimeter levee.

The construction of the two interior levees will consist of the following general construction sequence:

(1) Place woven geotextile beneath levee embankment.

(2) Place and compact interior levee fill.

7.5.3 Bridge Construction

The bridge construction will require the drilling and blasting of the abutments for construction of the foundations. To expedite the construction schedule, the canal section in the vicinity of the bridges could be constructed first to allow construction of the bridges to proceed on a parallel schedule with the remainder of the seepage canal and levees. The bridge abutments will be cast-in-place reinforced concrete, and the bridge girders will be standard AASHTO prestressed beams. The AASHTO beams will likely be fabricated off-site and transported to the bridge location. Transport of the 70 to 75 foot long beams should not be a problem. The beams will be placed with a crane and the bridge deck will be cast-in-place. The earthen approach roadways will be constructed with conventional earth moving equipment.

7.5.4 Pump Station and Pipeline

Dewatering will be required for the construction of the reinforced concrete pumping station. Blasting will also be required for foundation construction and for the intake and discharge pool and for construction of the 96-inch diameter discharge pipeline.

7.6 PROJECT SCHEDULE

A preliminary design and construction schedule is presented on Figure 37. Based on a start date of January 8, 2001, the project can be completed by December 2003, provided the following scheduling constraints are met:

- Condemnation authority will be available for use in land acquisition and property required for construction is purchased by June 2002.

- Environmental Resource Permit submittal and approval within 8 months of project start.

- Project is self-mitigating through overall hydrologic restoration of NESRS.

- Comment periods for design submittals are limited to 30 days.

To meet the project schedule, non-standard contracting procurement strategies may need to be considered if there is slippage in the land acquisition or permitting process. The land acquisition and permitting process currently have 2 and 6 months of float time, respectively, however, this float time could be reduced if delays occur. Contracting procurement strategies would include the following:

- Design/build opportunity

- Penalty/incentive contract clause

Because of the fast track nature of this project and the type of construction, design/build opportunities should be evaluated. The ability of a design/build team to complete the project on schedule will be dependent on the time required for land acquisition and permitting.

It may be appropriate to consider incentive/penalty contract clauses if there is slippage in the construction start date. Based on the current schedule, 15 months is allowed for construction. This is a relatively tight schedule and delays in either land acquisition or permit issuance could require a compression to this construction schedule.

7.7 PROJECT DESIGN/CONSTRUCTION ISSUES

Project engineering issues include design and construction activities that may impact the residents in the 8.5 SMA, project cost, and project schedule.

Issues that may be of interest to the engineering design team selected to complete the project design include:

- Site access for geotechnical exploration and field surveying

- Equipment specifications

- Construction phasing, maintenance of traffic

Site access for geotechnical exploration may be an issue if site access cannot be obtained at the start of the project in January 2001. This would impact the project schedule because the geotechnical investigation is a critical path task. Equipment specifications is an issue because the pumps for the pump station are potentially a long lead time item. This decision could impact the project schedule. Additionally, SFWMD needs to be directly involved in the specification and selection of all equipment since they have experience in the design and operation of similar pump stations and will be operating the equipment. There are definite advantages in buying pumps from the same manufacturer as used in other similar pump stations.

Construction phasing is important because there are residents between the perimeter levee and seepage canal. Therefore it may not be acceptable to excavate the entire channel without first constructing one of the bridges. Additionally, a maintenance of traffic plan will be required to inform the residents on the construction phasing and alternative routes to access their property.

Construction issues may also include:

- Noise and vibration abatement
- Dust Control
- Truck haul routes

Construction noise and equipment and blast vibrations may be a concern depending on the noise and vibration levels that are produced. Noise levels may be a nuisance to the residents if construction activities outside of a 50-hour work week are required to meet the project schedule. Dust control is a normal part of construction and can be mitigated with routine wetting, but is a greater concern for this project because of the truck traffic on unpaved residential roads.

Truck haul routes will need to be carefully selected because of the number of truck trips required to construct the perimeter levee and to transport materials to the site. A plan will be developed to address these issues.

7.8 PERMITTING

All necessary permits required for the project will be obtained before the start of construction.

7.9 REAL ESTATE

7.9.1 Lands and Easements

Lands needed within the footprints of the levees and seepage canal system and lands west and north of the perimeter levee will be acquired in fee to ensure they will be available over the life of the project. The total acreage required in fee will be 2,335 acres. Of the acres required in fee, 663 acres have been acquired by the Federal government at a cost of approximately $4,078,200. The SFWMD has acquired approximately 469 acres in fee that are located west and north of the perimeter levee at a cost of approximately $9,342,510. The Federal government will acquire the lands owned by the SFWMD for fair market value consideration and reasonable incidental costs of acquisition. Title to all project lands will be held by the Federal Government for project purposes and will grant to the SFWMD an outgrant for the lands to implement operation and maintenance responsibilities including management, maintenance, operation, repair and rehabilitation. This outgrant will be for nominal consideration.

A flowage easement will be acquired on approximately 546 acres. Easements will be acquired for flood mitigation purposes. Water levels will be increased in the area due to the project.

During pre-construction engineering and design studies, the location of the levees and seepage canal system may be shifted to minimize impacts to residents and the location of the perimeter levee may be realigned to maximize the amount of wetlands included west and north of the perimeter levee. Both of these possible levee realignments will follow the approximate boundary of Alternative 6D in the Recommended Plan.

The Federal government will be responsible for the acquisition of the flowage easements and the fee title to the lands not already acquired by the Federal Government or the SFWMD, approximately 1,203 acres.

The USACE has acquired approximately 1,050 acres that are located within the boundaries of the Everglades National Park Expansion area at a cost of approximately $3,600,000, in accordance with the terms of the Interagency Agreement the Department of Interior, National Park Service and the Department of Army dated June 1991. These lands will be transferred by USACE to the Department of Interior, National Park Service.

Based on the estimated product rent estate costs developed in Appendix D, the total land acquisition costs are estimated at $73,925,330.

7.9.2 Relocation Assistance (Public Law 91-646)

Preliminary estimates identified 107 residential homes or tenant occupied structures and one commercial establishment may be impacted. Relocation assistance will be provided to affected residents, tenants and businesses in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended (Public Law 91-646).

7.9.3 Construction Relocations

Utility lines may exist in the project area. All lands acquired which affect lines along the perimeter of the protective features (east and south of the perimeter levee and along the perimeter of the internal levee system) will be acquired to the extent possible, subject to any easements of record, and the lines will remain in place. If relocation of the lines is required, it will be determined during pre-construction engineering and design, and relocation agreements will be prepared. If the lines are west and north of the perimeter levee or within the footprint of the perimeter levee, they will be removed during the construction of the levee.

7.10 MCACES COST ESTIMATE

MCACES cost estimates were prepared for the Alternative 1 - Authorized GDM Plan and the Recommended Plan. These cost estimates are included in Appendix C, Preliminary Engineering and Costs. The total MCACES cost includes construction costs and a 20% contingency. The results of the cost analysis for Alternatives 1 and the Recommended Plan are presented in below.

Alternative 1

ITEM	COST
Capital	$ 34,359,800
Real Estate	$ 10,046,400
Total	$ 44,406,200

Recommended Plan

ITEM	COST
Capital	$ 32,615,900
Real Estate	$ 73,925,330
Total	$ 106,541,230

7.11 OPERATIONS AND MAINTENANCE

For the Recommended Plan, the proposed pump station S-357 will operate during high water levels. The pump station, which will be located at the junction of Richmond Drive and the proposed seepage canal, will "trigger" or turn on/off, based on water levels measured in a proposed stilling well to be located adjacent to the new seepage canal approximately 4,000-ft. to the west of L-31N canal. The pump will turn on when the stilling well water level is greater than 6.0-ft. NGVD. The pump will turn off when the stilling well water level is lower than 5.7-ft. NGVD.

O&M for the levee should consist of an annual visual inspection. A detailed inspection plan will be developed; however, at a minimum, the following should be noted during each inspection:

- Surface erosion gullies
- Excessive levee settlement
- Exposure of the geomembrane

The crushed processed canal rock material should be relatively durable and not prone to erosion. Planting vegetation on the slopes is not necessary as natural vegetation may occur with time. The shallow rooted vegetation may also reduce slope erosion. Any identified problem should be corrected.

The O&M costs for the pump station have been estimated based on information supplied by both the USACE and SFWMD. This cost is $298,950 per year and consists of specific operations and maintenance activities needed to insure that the generators and pumps operate as designed.

Annual visual inspection of the three bridges will be required. The bridges will require little maintenance; however, the roadway approach fills will require periodic maintenance to fill in potholes that will develop adjacent to the bridge approach slabs. Post-construction management of wetlands west of the perimeter levee includes quarterly interim management for the first year, biannual maintenance for years 2-4 and annual maintenance for the remaining life of the project.

SECTION 8.0
PUBLIC AND INTERAGENCY COORDINATION

8.1 SPONSOR VIEWS

The Governing Board of the SFWMD desires to restore water flows within ENP while balancing property rights of residents of the 8.5 SMA of south Miami-Dade County.

On June 15, 2000, the Governing Board passed a resolution concerning the mitigation of the 8.5 SMA. The resolution is as follows:

"Because of the features of Alternative 6D that optimize protection of wetlands and minimize impacts to landowners within the 8.5 square mile area (SMA), I move that the Board identify Alternative 6D as the optimal plan for the Modified Water Deliveries Project to Everglades National Park subject to the following design, feature enhancements and conditions:

(a) The Perimeter Levee's location and footprint should maximize the amount of wetlands included in the buffer area, following the approximate boundary in Alternative 6D.

(b) The Internal Levee and seepage canal system should be optimized to minimize impacts to the residents of 8.5 SMA. For example, the levee's location should avoid residences where practicable. Upon exhaustion of reasonable efforts to avoid landowner impacts, residents should receive fair market value or be provided equivalent property at no expense to themselves.

(c) Water quality treatment should be provided for the runoff to meet state water quality standards and not cause degradation of ambient conditions.

(d) Alternative 6D, including all required lands, should become a project feature of the Modified Water Deliveries Project. Therefore, construction and land acquisition shall be implemented through full federal funding, programs and/or procedures, consistent with the 1994 Project Cooperation Agreement.

(e) The potential for flooding of landowners which are east of the proposed levee, before and after project implementation is unchanged consistent with the federal Supplemental Environmental Impact Statement. Flood mitigation, not flood protection, should be provided by the design, construction and operation of Alternative 6D as enhanced herein.

(f) Miami-Dade County is strongly encouraged to enforce existing land use ordinances in order to preserve existing uses and densities, and sustain a willing seller program for all lands within the entire 8.5 square mile area.

(g) We endorse SFWMD plans for those lands within the 8.5 square mile area which fall east of the proposed levee, a willing seller program. All lands should continue utilizing appropriate and available programs and funds. The District shall utilize its regulatory authority to protect the water resources of the area and undertake rulemaking where necessary to address secondary and cumulative impacts. The District shall also exercise its authority to review any comprehensive plan amendments proposed by Miami-Dade County.

(h) Implementation of the Recommended Plan above, should not adversely harm the restoration levels of Everglades National Park's hydrology greater than that simulated through modeling of Alternative 6D. "

In a letter to the Jacksonville District Commander from the Executive Director of the SFWMD, dated June 21, 2000, the SFWMD urged a "immediate and swift Federal action" to implement an enhanced version of Alternative 6D as described in paragraphs (a) – (h) in the resolution.

8.2 VIEWS OF OTHER FEDERAL PARTNERS

Other Federal partners involved with this project include two DOI agencies, NPS and USFWS. The NPS and USFWS have prepared a FCAR, which is included as Appendix G to this Final GRR/SEIS. This report represents the Secretary of the Interior's report to Congress for this project.

The primary interests of these agencies are to restore hydropatterns to ENP to the extent practicable, assure that any water discharged into ENP meets water quality standards, and to protect existing habitats and enhance future habitats while ensuring that there is no impact to threatened and endangered species. These agencies are concerned with possible development within the 8.5 SMA as a result of secondary cumulative impacts of project implementation and the potential for this development to impede or reduce environmental benefits associated with the MWD Project. Therefore, they prefer those alternatives that involve full or partial acquisition in order to minimize impacts to the ENP area. The NPS believes that the Recommended Plan provides significant environmental benefits beyond that associated with Alternative 1.

These agencies are critical partners in this decision-making process because of the project's proximity to Everglades National Park and the cost sharing arrangements for project implementation.

8.3 VIEWS OF MIAMI-DADE COUNTY

The county will be affected by any alternative that impacts future development and future local costs. County Administration expressed significant concerns relating to the potential for increased development (density) within the 8.5 SMA, incurred costs due to implementation of any alternative, equitable distribution of costs for services to its citizens, and County requirements to provide local services to the area. The County Commission is generally unwilling to support any alternative that includes condemnation of private property.

8.4 VIEWS OF THE MICCOSUKEE TRIBE

In a letter to the Jacksonville District Commander from the Miccosukee Indian Tribe, dated June 28, 2000, they stated that they believe "the best way economically, environmentally, legally, and socially for the USACE to meet its obligations under PL 101-229 is (the) 1992 plan/concept as approved by Congress." In regards to the implementability of Alternative 6D as the Federally recommended plan, the tribe listed two serious concerns:

"1) Authority – how can you stay within the bounds of the law with 6D?: PL101-229 is crystal clear with regard to the 8.5 SMA, i.e., "The Secretary of the Army is authorized and directed to construct a flood protection system for that portion of presently developed land within such area."

2) Cost Effectiveness - how can you justify 6D as "cost effective"? 6D will require at least $62 million more in federal funds than the 1992 Corps plan. The Tribe strongly believes that $62 million is an underestimate and is certain to grow substantially as all costs are included."

In addition, the Tribe listed six conditions that they feel must be established and heeded for Alternative 6D to be implementable:

"1) 6D Plan must clearly demonstrate that construction will be completed and operation started by December 31, 2003.

2) 6D Plan must unequivocally ensure absolutely no condemnation of homes…also, it must ensure no condemnation of land, unless it is the land that falls beneath the footprint of the protective construction project, i.e. canal, levee, and pump;

3) 6D plan must provide property owners to the west of the 6D levee with choices that ensure they neither lose value of property/business nor quality of life. At a minimum, property owner must be permitted to choose among the 3 following options: a) continue to live in the area with roads, houses, and area around houses raised to the extent necessary to provide the protection directed by PL101-229 at 100 percent government expense; b) totally relocated to the 8.5 SMA east of the 6D levee at 100 percent government expense; or c) sell property for a price that permits total relocation outside the 8.5 SMA;

4) 6D Plan must be enforced by DOI in writing, to include an explicit commitment to provide the increased funding, prior to the Corps signing a Record of Decision (ROD);

5) 6D Plan ROD must be signed by September 20, 2000;

6) and 6D Plan must stipulate that, if any one of the above 5 immutables is not met, then the Corps must immediately begin final design and construction of the 1992 Corps plan/concept."

8.5 VIEWS OF LANDOWNERS, 8.5 SMA

Many landowners within the 8.5 SMA expressed an opinion that Everglades restoration is not dependent on the acquisition of 8.5 SMA and do not agree with relocation as an acceptable method of flood mitigation. These residents and landowners of the 8.5 SMA are in opposition to any alternative that results in relocation or the loss of property use within their community. On the other hand, several landowners did express a desire and willingness to sell their property within the 8.5 SMA, particularly given fair compensation and relocation assistance.

8.6 VIEWS OF AGRICULTURAL COMMUNITY

Agricultural views on this project include the concern for potential effects resulting from the flooding of farmlands, change in stage and/or regulation schedules that could impact farming operations east of L-31N, economic impacts to west and south Miami-Dade farmers, and water quality impacts.

8.7 VIEWS OF ENVIRONMENTAL GROUPS

Environmental groups, including the Florida Biodiversity Project, Sierra Club, World Wildlife Fund and Florida Audubon, overwhelmingly supported the

acquisition alternatives such as Alternatives 4 and 5. They believe acquisition is necessary to restore hydropatterns to NESRS and ENP, to maintain water quality, and to protect existing habitats and enhance future habitats while ensuring that there is no impact to threatened and endangered species. These groups are concerned with and opposed to development in proximity to ENP.

SECTION 9.0
PLAN IMPLEMENTATION

9.1 COST ALLOCATION

The Recommended Plan is a single purpose project and, therefore, cost allocation is not applicable.

9.2 COST APPORTIONMENT

Apportionment of project costs is in accordance with several Congressional Acts and interagency agreements. These authorizing documents include:

- Everglades National Park Protection and Expansion Act (PL 101-229, Section 104, December, 1989)

- Interagency Agreement Between the Department of the Interior, National Park Service, and the Department of the Army (Interagency Agreement No. IA-5000-1-9501, June 1991)

A complete description of these actions is included in Section 2.1 of this Final GRR.

Federal and non-Federal cost sharing percentages are categorized by project activity. The following table contains a breakdown of cost sharing percentages. In accordance with the above, the DOI will pay 100% of the cost for land acquisition and construction. The USACE will pay 75% of the cost for operation and maintenance. The SFWMD, as the local sponsor, will pay 25% of the cost for operations and maintenance for the recommended project, and 100% of the cost of the post-construction management of land outside of the perimeter levee.

The project cost, consisting of 34,500 ft of perimeter levee, 41,600 ft of internal levee, 20,800 ft seepage conveyance canal, pump station, treatment area, and pipeline to the C-111 project area and all the lands necessary to construct and operate this project, totals $106,541,230 which is to be 100% Federally funded. The annual operation and maintenance costs associated with this project total $616,500 and are cost shared 75% Federal and 25% non-Federal. The post-construction maintenance cost will be $67,500 and will be 100% non-Federal.

Distribution of Costs for Recommended Plan

	Federal		Non-Federal		Total Dollars
	Percentage	Dollars	Percentage	Dollars	
Land Acquisition ($M)	100	73.9	0	0	73.9
Construction ($M)	100	32.6	0	0	32.6
Total ($M)		106.5		0	106.5
Post Construction Land Management ($/yr)	0	0	100	67,500	67,500
Operation And Maintenance ($/yr)	75	411,750	25	137,250	549,000
Total ($/yr)		411,750		204,750	616,500

Notes: (1) Water Quality Monitoring is included with O&M costs. (2) Costs are annualized over 50 years.

9.3 IMPLEMENTATION SCHEDULE

A projected schedule for project phases is shown in Figure 38.

9.4 FEDERAL RESPONSIBILITIES

The DOI, pursuant to Interagency Agreement No. 1A-5000-1-9501, is responsible for budgeting for funds necessary to support USACE activities authorized under Section 104 of the 1989 Everglades National Park Protection and Expansion Act and amended in the PAC Report. Federal funding is subject to budgetary constraints imposed on the DOI by Congress. The costs for lands, easements, and rights-of-way needed for construction as well as lands acquired west and north of the perimeter levee would be 100% Federal responsibility. The USACE would perform the necessary pre-construction engineering and design needed prior to construction. The USACE will obtain State water quality certification and will be compliant with the State's Everglades Forever Act. The USACE would advertise, award and manage the execution of the construction contracts for the project. It is anticipated that separate construction contracts would be awarded for major separable components of the project. The Federal government will retain title to the project lands and grant an outgrant to the non-Federal sponsor for the lands to implement operation and maintenance responsibilities including sufficient rights for project operation, maintenance, management, repair, and rehabilitation. This outgrant will be for nominal

consideration. The Federal government will also be responsible for 75% of the annual O&M cost.

9.5 NON-FEDERAL RESPONSIBILITIES

The non-Federal sponsor, SFWMD, would accept responsibility for the completed Federal project and operate and maintain it in accordance with established procedures and regulations. The SFWMD would be responsible for 25% of the annual operation and maintenance cost, and 100% of post-construction management of those lands outside the perimeter levee. In accordance with the terms of local cooperation, title to the lands currently owned by the SFWMD will be transferred to the Federal government and SFWMD would be paid its reasonable land costs and reasonable and documented administrative costs.

9.6 ITEMS OF LOCAL COOPERATION

The SFWMD, as the local sponsor for this project, represents local interests and has certain responsibilities for cost sharing and long term project maintenance and operation. The specific requirements of local cooperation for the 8.5 SMA Recommended Plan, include the following:

(a) For so long as the project remains authorized, operate and maintain, repair, replace, and rehabilitate the completed Recommended Plan or functional portion of the Recommended Plan in accordance with applicable Federal and State laws and specific directions prescribed by the Government;

(b) Operate and manage at no cost to the Government all lands for the Recommended Plan north and west of the perimeter levee in accordance with a jointly developed management plan consistent with the purposes of the MWD Project to maximize ecological function and structure, restore hydrological conditions, effectively control exotic species, incorporate fish and wildlife enhancement features, and maintain wetland function;

(c) Cost share 25% of the operation and maintenance costs of the Recommended Plan and provide 100% of the post-construction operation and management costs of the lands for the Recommended Plan north and west of the perimeter levee;

(d) Convey for fair market value consideration and reasonable incidental costs of acquisition all lands, easements, and rights-of-way owned by the non-Federal Sponsor to the Government for the Recommended Plan

together with all maps, appraisals and other acquisition materials that may be of use to the Government;

(e) Hold and save the Government free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the Recommended Plan and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors;

(f) Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the Recommended Plan to the extent and in such detail as will properly reflect total project costs;

(g) To the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the Recommended Plan in a manner that will not cause liability to arise under CERCLA;

(h) Participate in and comply with applicable Federal flood plain management and flood insurance programs in accordance with Section 402 of Public Law 99-662, as amended;

(i) Prevent future encroachments on the project lands, easements, and rights-of-way, which might interfere with the proper functioning of the Recommended Plan;

(j) Not less than once each year, inform affected interests of the limitations of the mitigation afforded by the Recommended Plan;

(k) Publicize flood plain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the flood plain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with mitigation levels provided by the Recommended Plan;

(l) Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by title IV of the Surface Transportation and Uniform Regulations Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act;

(m) Comply with all applicable Federal and State laws and regulations, including section 601 of the Civil Rights Act of 1964, Public Law 880352, and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army."

(n) Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

(o) That as between the Government and the Non-Federal Sponsor that the non-Federal Sponsor shall be the operator of the Project for purposes of CERCLA liability.

(p) That the Non-Federal Sponsor shall investigate for hazardous substances as are determined necessary by the Government to identify the existence and extent of a hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, on lands being acquired by the Government for the construction, operation, and maintenance of the Recommended Plan at the Government's expense.

9.7 FINANCIAL ANALYSIS

A financial analysis is required for any plan being considered for USACE implementation that involves non-Federal cost sharing. The financial analysis obtained in connection with the existing PCA will be reviewed and updated as necessary by the sponsor. This will ensure that the non-Federal sponsor understands the financial commitment involved and has reasonable plans for meeting that commitment. The updated financial analysis shall include the non-Federal sponsor’s statement of financial capability, the non-Federal sponsor’s financing plan, and an assessment of the sponsors financial capability.

9.8 PROJECT COOPERATION AGREEMENT

The modified PCA and possible deviations based on the Recommended Plan have been fully discussed with the non-Federal sponsor. The non-Federal sponsor has a clear understanding of the type of agreement that they will be expected to sign prior to the start of construction.

The terms of the local cooperation to be required in the PCA modification are described in the “Recommendations” of this report (Section 11.0). The non-Federal sponsor’s (SFWMD) motion regarding an alternative for the MWD

Project, dated June 21, 2000, is contained in Appendix B of this report, and summarized in Section 8.1.

Federal commitments relating to a construction schedule or specific provisions of the PCA modification can not be made to the non-Federal sponsor on any aspect of this project or separable element until:

- The General Reevaluation Report is approved;
- Funds are allocated in accordance with the interagency agreement ; and
- The draft PCA modifications have been reviewed and approved by the office of the Assistant Secretary of the Army (CW).

The PCA modification will not be executed nor will construction be initiated on this project or any separable element until the National Environmental Policy Act, the Clean Water Act, the Coastal Zone Management Act, the Endangered Species Act, the Fish and Wildlife Coordination Act, and the National Historic Preservation Act planning phase requirements are met. In the case of the 8.5 SMA Project, these requirements are met once the FSEIS has been coordinated, comments responded to, and the document finalized.

9.9 SECTION 902

The original PCA for this effort contained an article (16) that referenced the application of Section 902 of PL 99-662, as amended, to the MWD Project. After further analysis, it has been determined that section 902 of PL 99-102 does not apply to the MWD Project because no total project dollar amount was expressed in the authorizing legislation as required. It is recommended that the original PCA for the MWD Project be modified to remove Article 16 as it does not apply.

SECTION 10.0
CONCLUSIONS

This GRR provided the opportunity to review and reevaluate the issues of flood mitigation and ecosystem restoration associated with the 8.5 SMA. Consideration has been given to all significant aspects of the Authorized Project in the overall public interest, including social and environmental effects and benefits, and engineering and feasibility.

The Recommended Plan best satisfies the project goals and objectives, established at the request of the local sponsor, and is consistent with the overall goals and objectives of the MWD Project. The Recommended Plan provides the optimum solution for providing flood mitigation to the landowners in the 8.5 SMA and environmental enhancement to ENP by balancing the environmental benefits and social impacts.

Miami-Dade County is strongly encouraged to enforce existing land use ordinances in order to preserve existing uses and densities, and sustain a willing seller program for all lands within the entire 8.5 SMA (to preclude increased runoff and degradation of water quality).

For those lands within the 8.5 SMA which fall east of the proposed perimeter and interior levees, a willing seller program, free from fear of condemnation, for all lands should be continued utilizing appropriate and available programs and funds. The SFWMD shall utilize its regulatory authority to protect the water resources of the area and undertake rulemaking where necessary to address secondary and cumulative impacts. The SFWMD shall also exercise its authority to review any comprehensive plan amendments proposed by Miami-Dade County.

SECTION 11.0
RECOMMENDATIONS

The project for the 8.5 SMA is an integral part of the MWD Project for ENP. Portions of the MWD Project have been implemented, but the benefits from the project cannot be fully utilized until the part for the 8.5 SMA is completed. The Recommended Plan as shown in Figure 39 will consist of perimeter and interior levees as well as a seepage canal and pump station with the following conditions:

(a) The perimeter levee location and footprint shall maximize the amount of wetlands included west and north of the perimeter levee, following the approximate boundary in Alternative 6D.

(b) Following the approximate boundary in Alternative 6D, the levees and seepage canal system should be optimized to minimize impacts to the residents of 8.5 SMA. For example, the levee's location should avoid residences and wetlands where practicable.

(c) Water quality treatment shall be provided for the existing runoff at the time of implementation to meet applicable state water quality standards and applicable permitting requirements and not cause degradation of ambient conditions. The water quality treatment for the Recommended Plan assumes regulatory control and enforcement actions.

(d) The Recommended Plan, including all required lands, shall become a project feature of the MWD Project. Therefore, construction and land acquisition shall be implemented as part of the project. The Federal government will retain title to the project lands and grant the non-Federal sponsor an outgrant for the lands to implement operation and maintenance responsibilities including sufficient rights for project operation, maintenance, management, repair and rehabilitation.

(e) The periodic flooding of landowners east of the proposed levee, before and after project implementation, will remain unchanged from conditions in existence prior to implementation of the MWD Project. Flood mitigation, not flood protection, should be provided by the design and operation of the Recommended Plan. No deviations are intended from the operations specified in the Manual (i.e., increased pumping in the seepage canal or the inclusion of additional pumps) due to anticipated public demand for increased flood relief inside the perimeter levee of the 8.5 SMA Project.

(f) Implementation of the Recommended Plan shall not adversely harm the restoration levels of ENP's hydrology greater than that simulated through modeling of Alternative 6D. A monitoring, evaluation, and reporting program shall be implemented to ensure operations are consistent with these levels.

(g) Operations of the 8.5 SMA Project shall be detailed in an Operations and Maintenance Manual. As appropriate, this Manual shall be agreed to by ENP, USFWS, USACE, and SFWMD, and include provisions for monitoring, emergency operations as well as mechanisms for dispute resolution to assure compliance in a manner satisfactory to all agencies.

(h) Seepage canal design will incorporate, insofar as practicable, enhancements that will increase the potential for improved water quality through biological treatment, and increase habitat for fish and wildlife. Additionally, all lands north and west of the perimeter levee and within the 8.5 SMA will be restored and managed to maximize the ecological quality of the area to the extent practicable.

(i) A Biological Assessment (BA) has been prepared under the provision of Section 7 of the Endangered Species Act. The BA evaluated likely project effects on five listed species that are known to, or might occur in the area affected by the project, including the wood stork, snail kite, eastern indigo snake, Florida panther, and Cape Sable seaside sparrow. This BA concluded that the project is not likely to adversely affect any of the listed species. Coordination with the USFWS has been initiated and their concurrence with this determination requested.

(j) Appropriate and reasonable noise abatement features such as walls surrounding the facility or interior building soundproofing will be constructed as needed in the vicinity of the proposed pumping facility.

It is recommended that the Recommended Plan be constructed at 100 percent Federal expense with the non-Federal sponsor being responsible for operation, maintenance, repair, replacement and rehabilitation of the Recommended Plan with a 75 percent Federal contribution for operations and maintenance and that the following items of local cooperation, in addition to the items of local cooperation contained in the General Design Memorandum for the Modified Water Deliveries to Everglades National Park, dated June 1992, shall be required of the non-Federal Sponsor:

(a) For so long as the project remains authorized, operate and maintain, repair, replace, and rehabilitate the completed Recommended Plan or functional portion of the Recommended Plan in accordance with applicable Federal and State laws and specific directions prescribed by the Government;

(b) Operate and manage at no cost to the Government all lands for the Recommended Plan north and west of the perimeter levee in accordance with a jointly developed management plan consistent with the purposes of the MWD Project to maximize ecological function and structure, restore hydrological conditions, effectively control exotic species, incorporate fish and wildlife enhancement features, and maintain wetland function;

(c) Cost share 25% of the operation and maintenance costs of the Recommended Plan and provide 100% of the post-construction operation and management costs of the lands for the Recommended Plan north and west of the perimeter levee;

(d) Convey for fair market value consideration and reasonable incidental costs of acquisition all lands, easements, and rights-of-way owned by the non-Federal Sponsor to the Government for the Recommended Plan together with all maps, appraisals and other acquisition materials that may be of use to the Government;

(e) Hold and save the Government free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the Recommended Plan and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors;

(f) Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the Recommended Plan to the extent and in such detail as will properly reflect total project costs;

(g) To the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the Recommended Plan in a manner that will not cause liability to arise under CERCLA;

(h) Participate in and comply with applicable Federal flood plain management and flood insurance programs in accordance with Section 402 of Public Law 99-662, as amended;

(i) Prevent future encroachments on the project lands, easements, and rights-of-way, which might interfere with the proper functioning of the Recommended Plan;

(j) Not less than once each year, inform affected interests of the limitations of the mitigation afforded by the Recommended Plan;

(k) Publicize flood plain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the flood plain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with mitigation levels provided by the Recommended Plan;

(l) Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by title IV of the Surface Transportation and Uniform Regulations Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and

maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act;

(m) Comply with all applicable Federal and State laws and regulations, including section 601 of the Civil Rights Act of 1964, Public Law 880352, and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army."

(n) Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

(o) That as between the Government and the Non-Federal Sponsor that the non-Federal Sponsor shall be the operator of the Project for purposes of CERCLA liability.

(p) That the Non-Federal Sponsor shall investigate for hazardous substances as are determined necessary by the Government to identify the existence and extent of a hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, on lands being acquired by the Government for the construction, operation, and maintenance of the Recommended Plan at the Government's expense.

It is also recommended that the original Project Cooperation Agreement for the MWD Project be modified to remove Article 16 as it does not apply.

CENTRAL AND SOUTHERN FLORIDA PROJECT
MODIFIED WATER DELIVERIES TO
EVERGLADES NATIONAL PARK, FLORIDA

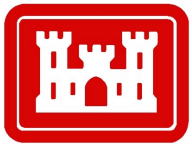
8.5 SQUARE MILE AREA

GENERAL REEVALUATION REPORT

TABLES

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

July 2000



HDR Engineering, Inc.

Table 1
Summary of Public Coordination

Meeting / Event	Attended	Date	Site	Purpose
Pre-Scoping Meeting	Various agencies and interested stakeholders	April 1, 1999	Homestead	Introduction meeting, preliminary discussion of work effort for EIS.
Pre-Scoping Meeting (SERA)	Various agencies and interested stakeholders	April 8, 1999	Ft. Lauderdale	Agency and public comment on project.
Scoping Meeting (NEPA requirement)	Public invited - included all residents, agencies, and interested stakeholders	June 21, 1999	Homestead	Project description was presented. Received public comment on project.
Technical Team Meeting	Technical representatives from various agencies.	August 4, 1999	West Palm Beach	Evaluate potential alternatives for further evaluation. Discuss modeling requirements.
Public Comment (Working Group of the SFERTF)	Public, various agencies, and interested stakeholders	Sept. 1-2, 1999	Homestead, Key Largo	Round table discussion with technical panel. Public comment received.
Public Workshop (NEPA requirement)	Public, various agencies, and interested stakeholders	October 6, 1999	Homestead	Presentation of 8.5 SMA alternatives. Public comment received.
Technical Team Meeting	Technical representatives from various agencies and interested stakeholders	October 7, 1999	Homestead	Discussion of critical issues, modeling needs, and performance measures.
Technical Team Meeting	Technical representatives from various agencies and interested stakeholders	October 27, 1999	Jacksonville	Modeling and alternatives analysis.
Technical Team Meeting	Technical representatives from various agencies and interested stakeholders	November 1999	Jacksonville	Modeling requirements and environmental issues.
SFWMD Governing Board Presentation	Governing Board and public	December 15, 1999	West Palm Beach	Presented status of project.

Table 1 (Continued)
Summary of Public Coordination

Meeting / Event	Attended	Date	Site	Purpose
Technical Team Meeting	Technical representatives from various agencies and interested stakeholders	January 4, 2000	Miami	Local cost issues discussed.
Technical Team Meeting	Technical representatives from various agencies and interested stakeholders	January 10, 2000	Ft. Lauderdale	Performance measures and modeling.
Public Workshop (Hosted by SFWMD)	Public, various agencies, and interested stakeholders	January 18, 2000	Homestead	Presentation of performance measures, modeling, and schedule. Public comment received.
Technical Team Meeting	Technical representatives from various agencies and interested stakeholders	January 19, 2000	Homestead	Discussion of performance measures.
SFWMD Governing Board Meeting	Governing Board and public	February 23, 2000	West Palm Beach	Present performance measures.
SFWMD Governing Board Meeting	Governing Board and public	April 12, 2000	West Palm Beach	Presentation of Draft GRR/SEIS
Public Workshop (Hosted by USACE)	Public, various agencies and interested stakeholders	April 26, 2000	Homestead	Presented overview of Draft GRR/SEIS. Receive public comment
SFWMD Governing Board Workshop	Governing Board and public	May 1, 2000	Homestead	Provide additional information to Governing Board
SFWMD Governing Board Workshop	Governing Board and public	May 10, 2000	West Palm Beach	Provide additional information to Governing Board

Table 2
Features of Alternatives

Feature	Alternative 1	Alternative 2B	Alternative 3	Alternative 4	Alternative 5	Alternative 6B	Alternative 6C	Alternative 6D	Alternative 7	Alternative 8A	Alternative 9
Name	Authorized GDM	Modified GDM	Deep Seepage Barrier	Landowner's Choice Acquisition	Total Buy-Out	Western Area as Buffer	Modified Western Area as Buffer (SOR)	Modified Western Area as Buffer	Raise All Roads	Western Area as Flow-Way	Adaptive Refinement of GDM
DDR Figure No.	Figure 4 (GRR)	Figure 5 (GRR)	Figure 6 (GRR)	Figure 7 (GRR)	Figure 8 (GRR)	Figure 9 (GRR)	Figure 10 (GRR)	Figure 11 (GRR)	Figure 12 (GRR)	Figure 13 (GRR)	Figure 14 (GRR)
Level of flood protection/mitigation	Mitigation	Mitigation	Protection	Mitigation	Mitigation	Protection	Mitigation	Mitigation	Mitigation	Mitigation	Mitigation
Mitigation/protection method	Levees, seepage canal, pump	Levees, seepage canal, pump	Levee and Seepage barrier	Land acquisition	Land acquisition	Levees, seepage canal, pump	Levees, seepage canal, pump	Levees, seepage canal, pump	Raise roads	Levees, seepage canal, pump/gate	Levees, seepage canal, pumps
Canal-levee system	Major Levee, seepage canal, minor levee	Major Levee, seepage canal, minor levee	Levee	None	None	Major Levee, seepage canal, minor levee	Major Levee, seepage canal, minor levee	Major Levee, seepage canal, minor levees	None	Major Levee, minor levee	Major Levee, seepage canal, minor levee
Length of new canals/levees	40,200 ft	40,200 ft	40,200 ft	n/a	n/a	20,600 ft	35,400 ft	34,500 ft 21,800 ft (1)	n/a	21,700 ft	40,200 ft
Amount of land acquisition needed	5%	5%	5%	TBD	100%	65%	27%	36%	0%	50%	5%
Seepage water management	Pump to L-31N	Pump to C-111 Buffer Area	Barrier - not needed	n/a	n/a	Pumped to C-111 Buffer Area	Pumped to C-111 Buffer Area	Pumped to C-111 Buffer Area	n/a	Pumped to C-111 Buffer Area	Pump to L-31N; Pump to C-111 Buffer Area
Seepage water treatment method	Discharge to L-31N	Overland Flow to C-111 Buffer Area	n/a	n/a	n/a	Overland Flow to C-111 Buffer Area	Overland Flow to C-111 Buffer Area	Overland Flow to C-111 Buffer Area	n/a	Overland Flow to C-111 Buffer Area	Discharge to L-31N; C-111 Buffer Area
Number of new structures	1	1	0	0	0	1	1	1	0	1	2
Preliminary Cost Estimate ($Million)	$30.6	$33.9	$235.8	$132.0	$179.0	$147.7	$62.8	$88.1	$134.6	$153.7	$39.9

Note (1) - Perimeter levee is 34,500 ft and interior levees/canal is 21,800 ft

Table 3
Features of Project Conditions

ID No.	Project Condition	Operating Procedure	Boundary Conditions	C-111 Project	8.5 SMA Alts Considered
CD1	Base 83	1983	1983	No	None
CD2	Base 95	1995	1995	No	None
CD3	Base 83 + Future w/o Project	1983	MWD (projected full implementation)	Yes	Alternative 1 *(Authorized Plan)*
CD4	Base 95 + Future w/o Project	1995	MWD (projected full implementation)	Yes	Alternative 1 *(Authorized Plan)*
CD5	Future w/ Project	1995	MWD (projected full implementation)	Yes	Alternatives 2-9

Table 4
Summary of Alternative Comparisons

ID No.	Comparison	Purpose of Comparison	Base Project Condition *	Proposed Project Condition *
CM1	Federal Requirement	Verify mitigation requirements met by each alternatives	CD1	CD4 & CD5
CM2	Impacts to Existing Conditions	Impacts of each alternative to current conditions	CD2	CD4 & CD5
CM3	Comparison to Authorized Plan	Differences in proposed alternatives to authorized plan	CD4	CD5

*Refer to Table 3 for features of project conditions.

Table 5
Description of Performance Measures

1. Evaluate the Effects on Hydropatterns in NESRS		
Measure	**Description**	**Metric/Comments**
a. Hydroperiod Impacts	Estimated acreage with increased and decreased hydroperiod within NESRS.	Total number of acres with increased or decreased hydroperiod as compared to the Base95 simulation for the area within NESRS. Determined by calculating the number of acres which have increased or decreased duration of water elevations above the ground surface.
b. Water depths	Estimated acreage with increased and decreased water depths within NESRS.	Total number of acres within NESRS with an increase or decrease in water depths. Determined by comparing the average annual change in water depth for each cell to the Base 95 simulation.
c. Effects on Seasonal variability	Change in stage variation (min, max, range) at key indicator cells.	Minimum/Maximum: Estimate min and max stages within NESRS from four-week average stage for the wet year simulation. Range: Compare changes in ranges for each indicator cell.
d. Duration of continuous flooding	Number of consecutive weeks with avg. weekly depths greater than 0.2 feet at key indicator cells.	Estimate the number of consecutive weeks of average weekly depths > 0.2 feet at key indicator cells in ENP.

2. Evaluate Impacts to the Landowners and Residents of the 8.5 SMA Resulting from Implementation of the MWD Project		
Measure	**Description**	**Metric/Comments**
a. Flood mitigation damages	Spatial extent of project-induced flood damages to areas designated for flood mitigation not prevented by mitigation structural features.	Area: Total number of acres within the 8.5 SMA where the total depth of inundation is greater than the comparison base condition (Base 83) during week 26 of the 1995 (wet) model year.
b. Flood protection damages	Spatial extent of project-induced flood damages to areas designated to receive 1-in-10 year flood protection not prevented by protection structural features.	Area: Total number of acres within designated protection area where the stage is greater than the existing ground surface elevation during week 23 of the 1995 (wet) model year.
c. Impacts to business	Potential direct or indirect loss to local business activity.	Number of businesses impacted due to location and/or specific alternative features and performance.
d. Impacts to Residences	Potential number of permanent and total residences requiring relocation.	Number of residences relocated due to location and/or specific alternative features and performance.
e. Lost agricultural lands	Potential number of acres of agricultural lands and associated annual economic losses.	Number of acres of agriculture lands and lost annual income which will no longer be available for agricultural uses due to an alternative.
f. Unwilling sellers	Time constraints associated with the conduct of this study prevented the development of a statistically reliable survey instrument and sample survey. As a result, specific estimates of the numbers of willing and unwilling sellers for each alternative have not been developed or reported herein.	

Table 5 (continued)
Description of Performance Measures

3. Analyze Cost Effectiveness		
Measure	**Description**	**Metric/Comments**
a. Project costs	Increase in overall project costs.	Actual estimated cost of the alternative; includes real estate, capital/construction costs and annual O&M costs.
b. Local Costs	Secondary impact costs to Miami-Dade County and/or residents.	Local costs potentially incurred as a result of any alternative implementation in conformance with applicable local ordinances.

4. Analyze Effects to Ecological Functions		
Measure	**Description**	**Metric/Comments**
a. Wetlands west of L-31N	Spatial extent of wetlands west of L-31N.	Number of acres with water level > -1.0 feet from ground surface and hydroperiod of 30 days or greater during the average year.
b. Short Hydroperiod wetlands	Spatial extent of short hydroperiod wetlands (Marl forming).	Number of acres with depth between –1.0 feet and 2.0 feet for 30 to 180 days during the average year.
Long Hydroperiod wetlands	Spatial extent of long hydroperiod wetlands (Peat forming).	Number of acres with depth between –1.0 feet and 2.0 feet for greater that 180 days during average the year.
c. WRAP Score	Function and value of wetlands.	Wetlands Rapid Assessment Procedure Functional Score at selected indicator cells.

5. Evaluate Effects on Conditions Favorable to Federal and State Listed Endangered Species Survival	
Measure	**Metric/Comments**
a. Cape Sable Seaside Sparrow	A Biological Assessment (BA) under the provisions of Section 7 of the Endangered Species Act (50 CFR 402), prepared by the USACE, has concluded that the project would not be likely to adversely affect any listed species. Coordination with the USFWS has been initiated and concurrence with this determination requested.

6. Measure Compatibility with CERP and C-111 Projects Without Adversely Impacting the Current Level of Flood Protection East of L-31N		
Measure	**Description**	**Metric/Comments**
a. Compatibility with CERP	Need for project features to be removed or significantly rehabilitated to accommodate the CERP goals and features.	Qualitative discussion and assessment of ability of each alternative to meet this objective.
b. Compatibility with C-111	Ability to accommodate the C-111 project requirements.	Qualitative discussion and assessment of ability of each alternative to meet this objective.
c. Agricultural lands east of L-31N	Potential increase in average annual stage to agricultural lands east of L-31N.	Average annual stage for the wet year from selected agricultural indicator cells.

Table 5 (continued)
Description of Performance Measures

7. Analyze Impacts and Costs Associated with Time Delays in Implementation of Alternatives		
Measure	**Description**	**Metric/Comments**
a. Environmental and cultural resources	Lost environmental resources due to higher water levels in WCA 3A, WCA 3B, and NESRS.	Qualitative discussion of the resources impacted if schedule is extended.
b. Ability to meet implementation schedule	Ability of each alt to be implemented before December 2003.	Qualitative discussion with statement of expected completion date.
c. Construction delays	Unknowns associated with constructability (including land acquisition issues).	Qualitative discussion of the implementation issues, that will impact scheduling.
d. Administrative requirements of alternatives	Estimate potential delays associated with admin requirements of any preferred plan.	Qualitative discussion of the administrative issues that will impact scheduling.

Table 6
Analysis of Project Requirements

This table presents the results of the evaluation for each alternative's attainment of the project requirements as outlined in Section 5.1

Requirements	Alternative 1	Alternative 2B	Alternative 3	Alternative 4	Alternative 5	Alternative 6B	Alternative 6C	Alternative 6D	Alternative 7	Alternative 8A	Alternative 9
1. Do not negatively impact higher stages in ENP as specified in MWD Project.	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets
2. Mitigate for increased stages within the 8.5 SMA resulting from implementation of the MWD Project. (1)	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets
3. Develop a solution that can be permitted by regulatory interests under current and reasonably foreseeable regulations.	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets
4. Ensure no significant impact to existing habitat of endangered or threatened species. (2).	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets
5. Maintain current levels of flood protection for agricultural areas east of L-31N.	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets	Meets

Notes:
1. Full mitigation for the 8.5 SMA is provided for each alternative through the use of structural and/or non-structural (i.e., easements) features. Certain alternatives required non-structural features or flowage easements to meet the goal of full flood mitigation.
2. A Biological Assessment (BA) under the provisions of Section 7 of the Endangered Species Act (50 CFR 402), prepared by the USACE, has concluded that the project would not be likely to adversely affect any listed species. Coordination with the USFWS has been initiated and concurrence with this determination requested.

Table 7
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 1: Evaluate effects on hydropatterns in NESRS.

Performance Measure:

PM1a: Hydroperiod Impacts

Source of Data:

- MODBRANCH modeling results for Base 95 and all alternatives – See Appendix A.

Procedure:

- Determine, for the cells located within the NESRS, the total number of days where water surface is above the ground for the Base95 condition
- Determine, for the cells located within the NESRS, the total number of days where water surface is above the ground for Alternative conditions.
- Determine which cells have an increase in the number of days and which cells have a decrease in the number of days.
- Calculate the total number of acres which have an increase or decrease in the number of days with water surface above the ground.

Results:

- All alternatives show an increase in hydroperiods as compared to the Base 95 condition. Increases range between a low of 24,842 acres for Alternative 2B to a high of 26,271 acres for Alternatives 3, 4, 5, 6B, 6D, 7, and 8A.
- Alternatives 1, 2B, 6C and 9, the perimeter levee and seepage canal alternatives show a decrease in hydroperiod for 1,114, 1,428, 471 and 1,271 acres respectively, accounting for the edge affect of the seepage canal.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 1: Evaluate effects on hydropatterns in NESRS.

Performance Measure:

PM1b: Water depths

Source of Data:

- MODBRANCH modeling results for existing conditions and all alternatives – See Appendix A.

Procedure:

- Computed area within ENP as the difference between the revised C-111 boundary and the 8.5 SMA
- Calculated the average annual depth of water within the NESRS for Base83, Base95, and all alternatives for both 1995 (wet year) and 1989 (dry year) precipitation conditions.
- Calculated the average change in water depth for each alternative for each cell as compared to Base 95.
- Calculated the number of acres with an increase (+) or decrease (-) in water depth.

Results:

- Data summarized in Appendix A.
- All of the alternatives show an increase in average annual depth when compared to Base95 conditions.
- Average annual depth for alternatives ranges from a low of 2.33 for Alternative 2B to a high of 2.59 for Alternative 3.
- All alternatives show an increase in number of acres with increased depths. Increases range from approximately 59,500 for alternatives 1, 2B, and 9, to approximately 62,000 for the other alternatives.
- Only Alternatives 1, 2B, 6C and 9 show a significant number of acres (ranging from 1400 to 2700 acres) with a decrease in depths.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 1: Evaluate effects on hydropatterns in NESRS.

Performance Measure:

PM1c: Seasonal variability

Source of Data:

- MODBRANCH models for existing conditions and all alternatives – See Appendix A, Tables 8 through 18.
- Modeling results included sliding 4-week average around maximum and minimum stages for all indicator cells in ENP.

Procedure:

- Computed a 4-week sliding average stage for the wet year for selected indicator cells.
- Reported the minimum and maximum 4-week stage for each selected indicator cell.
- The results from the indicator cells were averaged for each alternative for both maximum and minimum stages (See Table 11).
- The absolute range of stages was computed in the modeling for selected indicator cells in ENP Expansion Area. These values were averaged and reported (See Table 12).
- Locations of key indicator cells can be found in Figure 13.

Results:

- Data summarized in Tables 8 through 18 in Appendix A.
- All of the alternatives show an increase for both the four week average maximum and minimum when compared with Base 95 conditions.
- The maximum stages ranged from a low of around 8.05 (Alternatives 1, 2B, and 9) to a high of around 8.30 for Alternatives 3, 4, 5, 6B, 6D, 7 and 8A.
- There was not a significant difference in ranges for the alternatives as all were between 1.95 and 2.02.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 1: Evaluate effects on hydropatterns in NESRS.

Performance Measure:

PM1d: Flooding duration

Source of Data:

- MODBRANCH models for existing conditions and all alternatives – See Appendix A.
- Modeling results provided stages and groundwater elevations for each indicator cell in ENP.

Procedure:

- Used 9 indicator cells within the ENP Expansion Area.
- Determined the number of weeks within the 52-week simulations that the stage was above 0.2 feet for Base 95 conditions and all the alternatives.
- Averaged the continuous flooding duration for all ENP indicator cells for Base 95 and each alternative (See Table 13).
- Locations of key indicator cells can be found in Figure 13.

Results:

- Weeks of continuous flooding duration range from 39 (Base 95 and Alternative 1) to 45 (Alternatives 6B, 6D, and 8A).

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 2: Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the MWD Project.

Performance Measure:

PM2a: Flood Mitigation Damage

Source of Data:

- MODBRANCH models for all alternatives – See Appendix A.
- Social Impacts Analysis – See Appendix E
- Modeling results provided information on the extent and location of areas mitigated by the structural components within the 8.5 SMA.
- Graphics in Appendix A provide duration of continuous inundation for each alternative.

Procedure:

- For each alternative, determined the number of acres where depth of inundation is greater that the Base 83 conditions in week 26 (i.e., worst cast scenario) of the wet year simulation.
- Overlayed "mitigation area" graphics from modeling to determine extent of area not mitigated by structural features within 8.5 SMA.
- Estimated acreage not mitigated by structural features for each alternative.
- Calculated the percentage of the 8.5 SMA provided mitigation by structural features vs. non-structural features for each alternative.
- Alternatives 3 and 6B are protection alternatives, but are still analyzed for ability to provide mitigation.
- NOTE: Alternatives 4 and 5 are non-structural alternatives only, and do not apply to this measure.

Results:

- Alternatives 1, 2B, 6C and 9 are considered to provide mitigation utilizing structural means without additional non-structural features.
- Alternatives 3 (4693 ac), 6B (150 ac), 6D (546 ac), 7 (4404 ac) and 8A (2013 ac) require the purchase of flowage easements to provide supplemental mitigation for increased water depths.

NOTE: All properties receive full flood mitigation. Those areas not receiving through structural features will be supplemented through flowage easements or purchase of property.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 2: Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the MWD Project.
Performance Measure: PM2b: Flood Protection Damage
Source of Data: ➢ MODBRANCH models for all alternatives – See Appendix A. ➢ Social Impacts Analysis – See Appendix E ➢ Modeling results provided information on the extent and location of areas protected from the 1 in 10 year flood event by structural features of each alternative within the 8.5 SMA.
Procedure: ➢ For each alternative, determined the number of acres where depth of inundation is greater that the ground surface elevation in week 23 (i.e., worst cast scenario) of the wet year simulation. ➢ Overlayed extent of "protection area" from modeling on 8.5 SMA. ➢ Estimated acreage of area not protected by structural features for each alternative. ➢ Calculated the percentage of the 8.5 SMA provided protection by structural features vs. the percentage provided mitigation by non-structural features for each alternative. ➢ NOTE: This applies only to Alternatives 3 and 6B.
Results: ➢ Alternatives 3 and 6B were projected to provide flood protection through structural measures. ➢ Alternative 6B provides full flood protection for all but 150 ac. of the designated protection area. Flowage easements are required for this 150 acres since flood mitigation is not provided. ➢ Alternative 3 provides protection from structural features for only 9% of the 8.5 SMA and 18% is provided flood mitigation. 73% of the area needs to be supplemented by non-structural measures to provide mitigation.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 2: Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the MWD Project.

Performance Measure:

PM2c: Impacts to Businesses

Source of Data:

- MODBRANCH models for all alternatives – See Appendix A.
- Social Impacts Analysis – See Appendix E
- Land Use data from DERM verified, as appropriate, by field reconnaissance

Procedure:

- Identified the number and location of commercial activities within the 8.5 SMA
- Identified those businesses within the boundaries of the non-mitigated area for each alternative that would require buy-out.
- Calculated the percentage of the businesses within 8.5 SMA requiring purchase by the government.

Results:

- 4 businesses are impacted from Alternatives 4 and 5 due to the non-structural measures (i.e., buy-out or flowage easements) imposed for the entire area.
- There are no impacts to businesses from any of the structural alternatives (Alternatives 1, 2B, 3, 6B, 6C, 6D, 7, 8A, and 9).

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 2: Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the MWD Project.

Performance Measure:

PM2d: Impacts to Residences

Source of Data:

- MODBRANCH models for all alternatives – See Appendix A.
- Social Impacts Analysis – See Appendix E
- Land Use data from DERM verified, as appropriate, by field reconnaissance

Procedure:

- Identified the number and location of permanent and total residences within the 8.5 SMA
- Identified those residences within the boundaries of the non-mitigated area that would be impacted and/or required to be relocated as a result of each alternative.
- Calculated the percentage of the residences within 8.5 SMA, for each alternative, that were impacted.

Results:

- Impacts range from the relocation of a high of 208 owner occupied and 306 non-owner occupied residences in Alternative 5, to 1 relocated residence (for Alternatives 1, 2, 3, 7 & 9)

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 2: Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the MWD Project.

Performance Measure:

PM2e: Impacts to Agricultural Lands

Source of Data:

- MODBRANCH models for all alternatives – See Appendix A.
- Social Impacts Analysis – See Appendix E
- Land Use data from DERM verified, as appropriate, by field reconnaissance

Procedure:

- Identified the location and extent of agricultural production within the 8.5 SMA.
- Identified those agricultural areas within the boundaries of the non-mitigated (or non-protected) area for each alternative.
- Calculated the percentage of the agricultural lands within 8.5 SMA provided protection by structural features vs. the percentage provided mitigation by non-structural features for each alternative.
- Estimated annual lost income for all (residential and non-residential) agricultural lands. (Appendix E).

Results:

- Impacts range from a high of 2642 acres (for Alt. 5) to a low of 0 acres (for Alt. 1, 2B, 3, 4, 7, and 9).
- Lost annual income ranges from a high of $6.46M (Alt. 5) to a low of 0 (Alt. 1, 2B, 3, 4, 7 and 9).

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 2: Evaluate impacts to the landowners and residents of the 8.5 SMA resulting from implementation of the MWD Project.
Performance Measure: PM2f: Unwilling Sellers
Procedure: ↘ A number of informal surveys were made of homeowners and landowners within the 8.5 SMA to determine their willingness or unwillingness to sell their properties for the implementation of the alternatives, particularly the buy-out alternatives. These unscientific surveys have widely diverse results and are considered unreliable because of the uncontrolled nature of the survey instruments that would have eliminated or minimized any biased questions or responses. It is not sufficient to ask an individual about their willingness to sell their property without determining the threshold that would trigger their willingness to sell their property. This is to say that individuals may not be willing to sell their property at, for example, $1,000 per acre, but would be more than willing to sell their property at $5,000 per acre. A properly developed survey instrument would have helped identify these types of bias free data.
Results: ↘ Time constraints associated with the conduct of this study prevented the development of a statistically reliable survey instrument and sample survey. As a result, specific estimates of the numbers of willing and unwilling sellers for each alternative have not been developed or reported herein.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 3: Analyze cost effectiveness.

Performance Measure:

PM3a: Project costs

Source of Data:

- Engineering Design and Cost Estimates – Appendix C
- Real Estate Supplement - Appendix D

Procedure:

- The Engineering Appendix included cost estimates for all capital and operation and maintenance costs. Costs were derived from previous projects with similar construction requirements.
- The Real Estate Appendix included estimates of cost for the acquisition needs (buy-out and flowage easements) for each alternative.

Results:

- The highest real estate costs were for the buyout alternative (Alternative 5); the lowest costs were for Alternatives 1, 2B, and 9 where the property acquisition is minimal.
- The highest capital cost is for Alternative 3 due to the expense of constructing an impervious seepage barrier. The lowest cost is for Alternative 4.
- Total costs range from $30.6 mil for Alt. 1 to $235.8mil for Alt. 5
- The highest annual operation and maintenance cost is for Alternative 7. Alternatives 3,4, and 5 have the lowest O&M costs.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 3: Analyze cost effectiveness.

Performance Measure:

PM3b: Local Costs

Source of Data:

- Local Cost Analysis – Appendix F
- Social Impact Assessment – Appendix E
- Land Use Study from DERM

Procedure:

- A determination of existing land use was utilized from the DERM land use study.
- Future land use was calculated for various scenarios.
- The cost for local services was determined from the projected future land use and the associated need for local services.
- The local cost analysis was limited to Alternative 6B since this is the only alternative formulated to reduce flood stages to the 1 in 10-year flood event.

Results:

- Capital costs for local services for Alternative 6B is $35.8M.
- O&M costs for local for Alternative 6B is $0.9M.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 4: Analyze effects to ecological functions.

Performance Measure:

PM4a: Wetlands West of L-31N

Source of Data:

- MODBRANCH Model results for all alternatives – See Appendix A
- Modeling results provided information on the stage and duration of areas in ENP Expansion area and the 8.5 SMA.

Procedure:

- Wetlands defined as those areas with water levels not less than –1.0 feet below ground level, and a hydroperiod between 30 and 360 days.
- The model output defined the areas within the area of potential effect that met this hydrologic criteria.
- Spatial extent of total wetlands within the study area is presented.

Results:

- Acreage values ranged from approximately 60,000 for Alternative 3, to approximately 62,400 for Alternatives 4, 5 and 7. This represents approximately a 4% variation.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 4: Analyze effects to ecological functions.

Performance Measure:

PM4b: Short Hydroperiod & Long Hydroperiod Wetlands

Source of Data:

- MODBRANCH Model results for all alternatives – See Appendix A
- Modeling results provided information on the stage and duration of stages in ENP Expansion area.

Procedure:

- Computed spatial extent of short hydroperiod (marl forming) and long hydroperiod (peat forming) wetlands meeting the hydrologic definition for marl prairie.
- The model output provided a summary of areas meeting the criteria for short hydroperiond wetlands (water depth within –1.0 to 2.0 feet for 30 to 180 days); and for long hydroperiod wetlands (water depth less than –1.0 feet for more than 180 days)

Results:

- All alternatives resulted in a reduction in marl forming short hydroperiod wetlands when compared to existing conditions (base 95), suggesting an increase in hydroperiod, or possible wetland loss due to dry down associated with some structural alternatives. Reductions ranged from 5,283 (Alternative 3) to 3,954 (Alternatives 4, 5, and 7).
- Long hydroperiod wetlands (peat forming) increased in acreage for each alternative when compared to existing conditions. Increases ranged from 12,687 acres (Alternative 2B) to 10,839 acres (Alternative 6C).
- Increases in spatial extent of long hydroperiod wetlands appear to be a result of general increases in hydroperiod throughout the study area.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 4: Analyze effects to ecological functions.

Performance Measure:

PM4c: WRAP score

Source of Data:

- Data was taken directly from the Final CAR.

Procedure:

- Wetlands Rapid Assessment Procedure Functional Score at selected indicator cells.

Results:

- The WRAP scores ranged from 15,853 functions units (FU) for Alternatives 4 & 5 to 10,640 FU for Alternatives 1, 2B, & 9. Alternative 6D resulted in 14,727 FU, roughly 97% of the functional lift generated by Alternative 5, the environmentally preferred Alternative.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 5: Evaluate effects on conditions favorable to Federal and State listed endangered species survival.

Performance Measure:

PM5a: Cape Sable Seaside Sparrow

Source of Data:

- MODBRANCH models for all alternatives – See Appendix A.
- Final Coordination Act Report
- Biological Assessment

Procedure:

- The USFWS is a cooperating agency with the USACE and has been an active participant in the development and evaluation of all alternatives. The FCAR identified several species of key concern, identified significant habitat locations and presents issues and strategies concerning the preservation and protection of these areas.

Results:

- A Biological Assessment (BA) under the provisions of Section 7 of the Endangered Species Act (50 CFR 402), prepared by the USACE, has concluded that the project would not be likely to adversely affect any listed species. Coordination with the USFWS has been initiated and concurrence with this determination requested.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 6: Measure the compatibility with CERP and C-111 projects without adversely impacting the current level of flood protection east of L-31N.

Performance Measure:

PM6a: Compatibility with CERP

Source of Data:

- Restudy Report (CERP)
- Coordination with CERP project team

Procedure:

- The relative compatibility of the alternative with CERP was measured using qualitative indicators of red, yellow and green. These indicators were selected because their recent use in the CERP. Green indicates relative ease of incorporation into local and regional CERP components and objectives. Yellow indicates that alternative may need some manipulation to be in full compliance, while red indicates higher potential for non-compatibility.

Results:

- In a broad sense, all of the alternatives are considered to meet the general goal of CERP since they result in an increase in depth in the NESRS. Therefore each received a green indicator. See additional discussion in Section 5.2.6.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 6: Measure the compatibility with CERP and C-111 projects without adversely impacting the current level of flood protection east of L-31N.

Performance Measure:

PM6b: Compatibility with C-111

Source of Data:

- C-111 project is being completed concurrently with this effort. Information gathered from discussions with project team.

Procedure:

- The relative compatibility of the alternative with the C-111 project was measured using qualitative indicators of red, yellow and green. These indicators were selected because their recent use in the CERP. Red indicates the potential for non-compatibility, while green indicates relative ease of incorporation into local C-111 components and objectives.

Results:

- Alternatives 2B, 6B, 6C, 6D, 8A and 9 were assigned with green indicators since these alternatives discharge all or portions of the flows to the south into the C-111 buffer area.
- Alternative 1 was assigned a red indicator because it discharges water directly away from the C-111 project area.
- All other alternatives (3, 4, 5 and 7) were assigned with yellow indicators. While not in conflict with C-111 project, they do not directly support the concept of the hydrologic buffer associated with the C-111 project.
- See additional discussion in Section 5.2.6.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 6: Measure the compatibility with CERP and C-111 projects without adversely impacting the current level of flood protection east of L-31N.
Performance Measure: PM6c: Agricultural Lands East of L-31N
Source of Data: ➢ MODBRANCH models for existing conditions and all alternatives – See Appendix A. ➢ Modeling results provided stages and groundwater elevations for each indicator cell in the agricultural lands east of L-31N.
Procedure: ➢ Stages were determined for indicator cells in the agricultural areas east of L-31N for all alternatives. ➢ Comparisons were made for each alternatives to the Base 95 and Alternative 1 scenarios. ➢ An average of the stages for all indicator cells was determined for the area. ➢ Locations of key indicator cells can be found in Figure 13.
Results: ➢ The stage for all alternatives ranged from 6.52 (Alternative 6C) to 6.72 (Alternative 1). ➢ The stage for the Base 95 condition is 6.32 ➢ These results are highly influenced by boundary conditions (i.e., D13R flows and stages) and are not a direct result of the Alternatives. Alternative 1, because of its pump location, will have a slight negative impact on agricultural lands. It is recommended that an Operation EIS for the conveyance and seepage system be developed. Operational protocols can be modified to mitigate for impacts.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 7: Analyze impacts and costs associated with time delays in implementation of alternatives.

Performance Measure:

PM7a: Environmental and Cultural Resources

Source of Data:

- Various research
- Restoration project data

Procedure:

- The loss of tree islands has an impact on the critical habitats and cultural resources. SFWMD staff presented rates of degradation of tree islands in WCA-3 to the Federal Working Group Panel Discussion on September 1, 1999. The total number of tree islands as well as the spatial extent of the tree islands within WCA-3 has been determined from photographs dated 1940 and 1995.

Results:

- This data shows a total decrease in the number and acreage for the 55-year period as 45% and 61%, respectively. Assuming a linear relationship for the changes in tree islands, this is estimated as loss of 8.4 islands and 246 acres per year. Delayed implementation of MWD will prolong the restoration and recovery process for the tree islands in WCA-3. Estimated values for full restoration of tree islands may ranged from $50,000 to $500,000 per acre.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 7: Analyze impacts and costs associated with time delays in implementation of alternatives.

Performance Measure:

PM7b: Implementation Schedule

Source of Data:

- Engineering Appendix – Implementation schedule
- The current schedule anticipates full implementation of MWD components by December 2003.

Procedure:

- The relative compatibility of the alternative with the required implementation schedule was measured using qualitative indicators of red, yellow and green. Red indicates the potential for difficulty in meeting the deadline, while green indicates expected implementation by the specified deadline.
- Preliminary Implementation schedules were developed and presented in the Engineering Appendix.

Results:

- Alternatives 1, 2B, and 9 were assigned with green indicators since these alternatives are or closely approximate the authorized plan, where implementation could proceed with current authority and agreements.
- Alternative 3 was assigned with a yellow indicator because of overall concerns of implementation of this alternative due to both construction issues and easement requirements.
- Alternatives (4,5,6B, 6C, 6D, 7 and 8A) involving land acquisition or flow-way easements were assigned with red indicators due to the anticipated time requirements during the acquisition process.
- All alternatives can be expected to be completed by Dec. 2003.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 7: Analyze impacts and costs associated with time delays in implementation of alternatives.

Performance Measure:

PM7c: Construction Delays

Source of Data:

- Engineering Appendix.
- Past experience with previous Everglades restoration and construction projects.

Procedure:

- The relative potential for construction delays was measured using qualitative indicators of red, yellow and green. Green indicates that there are no major concerns with delays associated with construction of the alternative. Red indicates an uncertainty in the construction sequence or methods, and a potential concern that constructability issues could delay implementation of the project.

Results:

- Alternatives 1, 2B, 6B, 6C, 6D, 7 and 9 were assigned with green indicators since the structural features included in these alternatives are typical construction activities in south Florida.
- Alternative 3 was assigned with a red indicator because of concerns of implementation of this alternative due to the construction of a deep seepage barrier.

Table 7 (continued)
Alternative Analysis Fact Sheets
This table presents the results of the
alternatives analysis as outlined in Section 5.2

Objective 7: Analyze impacts and costs associated with time delays in implementation of alternatives.

Performance Measure:

PM7d: Administrative Requirements

Source of Data:

- Discussions with USACE Project Management Staff
- Experience with other similar Federal projects.

Procedure:

- The anticipated administrative requirements for each alternative were measured using qualitative indicators of red, yellow and green.
- Red indicates the potential for significant delay associated with administrative requirements of the project.
- Green indicates that minimal administrative requirements are expected, or that any additional requirements can be accomplished in a timely manner.

Results:

- Alternatives 1, 2B, and 9 were assigned with green indicators since these alternatives are or closely approximate the authorized plan, and implementation could proceed with current authority and agreements.
- Alternatives 4, 5, 6B, 6C, 6D, 7 and 8A would require an amended PCA and were designated with a red indicator.

Table 8
Results of Alternatives Analysis

This table presents the absolute values for each performance measure.

1. Evaluate Effects on Hydropatterns in NESRS.

Measure	Units	Base 95	Alt 1	Alt 2B	Alt 3	Alt 4	Alt 5	Alt 6B	Alt 6C	Alt 6D	Alt 7	Alt 8A	Alt 9
a. Hydroperiod Impacts[(1)]	Increased Hydroperiod (ac)	N/A	25,156	24,842	26,271	26,271	26,271	26,271	25,799	26,271	26,271	26,271	24,999
	Decreased Hydroperiod (ac)	N/A	1,114	1,428	0	0	0	0	471	0	0	0	1,271
b. Water depths[(1)]	Increased depth (ac)	N/A	59,360	59,578	62,396	62,125	62,125	62,068	60,643	62,068	62,125	62,029	59,469
	Decreased depth (ac)	N/A	2,707	2,489	0	0	0	0	1,425	0	0	95	2,598
c. Effects on Seasonal variability	Minimum stage, (ft)	5.59	6.61	6.69	6.95	6.83	6.83	6.86	6.97	6.84	6.83	6.91	6.65
	Maximum stage, (ft)	7.89	8.05	8.07	8.34	8.25	8.25	8.29	8.17	8.25	8.25	8.31	8.06
	Range of stage, (ft)	2.54	2.02	1.95	1.96	1.95	1.95	1.97	1.97	1.96	1.95	1.94	1.98
d. Duration of continuous flooding	Consecutive weeks of inundation	39	39	42	42	42	42	45	43	45	42	45	41

[(1)] Value represents the comparison of each alternative versus the Base 95 Condition

2. Evaluate Impacts to the Landowners and Residents of the 8.5 SMA Resulting From Implementation of the Modified Water Deliveries Project.

Measure	Units	Base 95	Alt 1	Alt 2B	Alt 3	Alt 4	Alt 5	Alt 6B	Alt 6C	Alt 6D	Alt 7	Alt 8A	Alt 9
a. Flood mitigation damages	Area of damages, (ac, %)	0	0	0	4693 73%	N/A	N/A	150 2%	0	546 9%	4404 69%	2013 31%	0
b. Flood protection damages	Area of damages, (ac, %)	0	N/A	N/A	5825 91%	N/A	N/A	150 2%	N/A	N/A	N/A	N/A	N/A
c. Impacts to business	No. of businesses impacted	0	0 0%	0 0%	0 0%	4 100%	4 100%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
d. Impacts to Residences	No. of residences impacted	0	1 0.5%	1 0.5%	1 0.5%	17 8%	208 100%	129 62%	17 8%	35 17%	1 0.5%	104 50%	1 0.5%
	Total no. of structures impacted	0	1 0.2%	1 0.2%	1 0.2%	41 8%	514 100%	319 62%	41 8%	87 17%	1 0.2%	258 50%	1 0.2%
e. Impacts to agricultural lands	Lost area (ac)	0	0 0%	0 0%	0 0%	0 0%	2,642 100%	1,175 44%	51 2%	215 8%	0 0%	900 34%	0 0%
	Lost annual income ($M/yr)	0	0	0	0	0	6.46	2.78	0.125	0.53	0	2.20	0
f. Unwilling sellers	No. of property owners	Time constraints associated with the conduct of this study prevented the development of a statistically reliable survey instrument and sample survey. As a result, a specific estimate of the numbers of unwilling sellers has not been developed.											

3. Analyze Cost Effectiveness

Measure	Units	Base 95	Alt 1	Alt 2B	Alt 3	Alt 4	Alt 5	Alt 6B	Alt 6C	Alt 6D	Alt 7	Alt 8A	Alt 9
a. Project costs	O&M and Replacement Costs ($M/yr)	0	.27	.33	0	0	0	.33	.33	.40	.43	.35	.37
	Real Estate Costs ($M)	0	4.1	4.1	110.2	122.8	164.8	115.0	30.7	55.7	110.5	127.0	4.1
	Capital Costs ($M)	0	26.5	29.8	125.6	9.2	14.2	32.7	32.1	32.4	24.1	26.8	35.8
	Total Initial Project Costs ($M)	0	30.6	33.9	235.8	132.0	179.0	147.7	62.8	88.1	134.6	153.7	39.9
b. Local Costs	Capital Cost ($M)	0	0	0	0	0	0	36	0	0	0	0	0
	Annual O&M Costs ($M/yr)	0	0	0	0	0	0	0.90	0	0	0	0	0

1) Capital cost includes all design and construction management costs and contingency; it does not include real estate costs.
2) O & M and Replacement costs are presented as annual costs.
3) O & M costs do not include ecological O & M or water quality monitoring.
4) Real estate costs include all fee simple acquisition and flowage easements.

Table 8 - Continued
Results of Alternatives Analysis

This table presents the absolute values for each performance measure.

4. Analyze Effects to Ecological Functions													
Measure	**Units**	**Base 95**	**Alt 1**	**Alt 2B**	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6B**	**Alt 6C**	**Alt 6D**	**Alt 7**	**Alt 8A**	**Alt 9**
a. Wetlands west of L-31N	Area (Ac)	54,429	61,625	62,012	59,985	62,372	62,372	61,543	61,117	61,893	62,372	60,902	61,820
b. Short-Hydroperiod Marl Forming Wetlands	Area (Ac)	6,353	1,690	1,249	1,070	2,399	2,399	2,074	1,290	2,055	2,399	1,908	1,470
c. Long-Hydroperiod Peat Forming wetlands	Area (Ac)	48,076	59,935	60,763	58,915	59,973	59,973	59,469	59,827	59,838	59,973	58,994	60,350
d. WRAP Score	Functional Units	13,405	10,640	10,640	11,630	15,853	15,853	15,011	11,600	14,727	14,695	15,645	10,640
5. Evaluate Effects on Conditions Favorable to Federal and State Listed Endangered Species Survival													
Measure	**Units**	**Base 95**	**Alt 1**	**Alt 2B**	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6B**	**Alt 6C**	**Alt 6D**	**Alt 7**	**Alt 8A**	**Alt 9**
a. Cape Sable Seaside Sparrow		A Biological Assessment (BA) under the provisions of Section 7 of the Endangered Species Act (50 CFR 402), prepared by the USACE, has concluded that the project would not be likely to adversely affect any listed species. Coordination with the USFWS has been initiated and concurrence with this determination requested.											
6. Measure compatibility with CERP and C-111 projects without adversely impacting the current level of flood protection east of L-31N													
Measure	**Units**	**Base 95**	**Alt 1**	**Alt 2B**	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6B**	**Alt 6C**	**Alt 6D**	**Alt 7**	**Alt 8A**	**Alt 9**
a. Compatibility with CERP	Qualitative (R/Y/G)	N/A	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
b. Compatibility with C-111	Qualitative (R/Y/G)	N/A	Red	Green	Yellow	Yellow	Yellow	Green	Green	Green	Yellow	Green	Green
c. Agricultural lands east of L-31N	Stage (ft)	6.32	6.72	6.57	6.67	6.69	6.69	6.58	6.52	6.62	6.69	6.67	6.65
7. Analyze Impacts and Costs Associated With Time Delays in Implementation of Alternatives													
Measure	**Units**	**Base 95**	**Alt 1**	**Alt 2B**	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6B**	**Alt 6C**	**Alt 6D**	**Alt 7**	**Alt 8A**	**Alt 9**
a. Environmental and cultural resources		See Section 5.2.7 in GRR for discussion of this measure											
b. Ability to meet implementation schedule	Qualitative (R/Y/G)	N/A	Green	Green	Yellow	Red	Red	Red	Red	Red	Red	Red	Green
c. Construction delays	Qualitative (R/Y/G)	N/A	Green	Green	Red	N/A	N/A	Green	Green	Green	Green	Yellow	Green
d. Administrative requirements of alternatives	Qualitative (R/Y/G)	N/A	Green	Green	Yellow	Red	Red	Red	Red	Red	Red	Red	Green

For the qualitative performance measures, alternatives were assessed as red, yellow or green. This terminology was selected due to its recent use for presentation and evaluation purposes in the Comprehensive Everglades Restoration Plan. A red designation generally signifies that there is significant concern that attainment of a specified objective as related to a performance measure may not be feasible. A yellow designation indicates marginal concern that attainment of the objective may be met with difficulties. A green designation signifies relative confidence in achieving the stated objectives

Table 9
Base 95 Comparison

This table presents the comparison of all alternatives to Base 95 (existing) conditions for each performance measure.

1. Evaluate Effects on Hydropatterns in NESRS.

Measure	Units	Base 95	Alt 1	Alt 2B	Alt 3	Alt 4	Alt 5	Alt 6B	Alt 6C	Alt 6D	Alt 7	Alt 8A	Alt 9
a. Hydroperiod Impacts	Increased Hydroperiod (ac)		25,156	24,842	26,271	26,271	26,271	26,271	25,799	26,271	26,271	26,271	24,999
	Decreased Hydroperiod (ac)		1,114	1,428	0	0	0	0	471	0	0	0	1,271
b. Water depths	Increased depth (ac)		59,360	59,578	62,396	62,125	62,125	62,068	60,643	62,068	62,125	62,029	59,469
	Decreased depth (ac)		2,707	2,489	0	0	0	0	1,425	0	0	95	2,598
c Effects on Seasonal variability	Minimum stage, (ft)		1.02	1.10	1.36	1.24	1.24	1.27	1.38	1.25	1.24	1.32	1.06
	Maximum stage, (ft)		0.16	0.18	0.45	0.36	0.36	0.40	0.28	0.36	0.36	0.42	0.17
	Range of stage, (ft)		-0.52	-0.59	-0.58	-0.59	-0.59	-0.57	-0.57	-0.58	-0.59	-0.60	-0.56
d. Duration of continuous flooding	Consecutive weeks of inundation		0	3	3	3	3	6	4	6	3	6	2

2. Evaluate Impacts to the Landowners and Residents of the 8.5 SMA Resulting From Implementation of the Modified Water Deliveries Project.

Measure	Units	Base 95	Alt 1	Alt 2B	Alt 3	Alt 4	Alt 5	Alt 6B	Alt 6C	Alt 6D	Alt 7	Alt 8A	Alt 9
a. Flood mitigation damages	Area of damages, (ac, %)		0	0	4693 73%	N/A	N/A	150 2%	0	546 9%	4404 69%	2013 31%	0
b. Flood protection damages	Area of damages, (ac, %)		N/A	N/A	5825 91%	N/A	N/A	150 2%	N/A	N/A	N/A	N/A	N/A
c. Impacts to business	No. of businesses impacted		0 0%	0 0%	0 0%	4 100%	4 100%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
d. Impacts to Residences	No. of residences impacted		1 0.5%	1 0.5%	1 0.5%	17 8%	208 100%	129 62%	17 8%	35 17%	1 0.5%	104 50%	1 0.5%
	Total no. of structures impacted		1 0.2%	1 0.2%	1 0.2%	41 8%	514 100%	319 62%	41 8%	87 17%	1 0.2%	258 50%	1 0.2%
e. Impacts to agricultural lands	Lost area (ac)		0 0%	0 0%	0 0%	0 0%	2642 100%	1175 44%	51 2%	215 8%	0 0%	900 34%	0 0%
	Lost annual income ($M/yr)		0	0	0	0	6.46	2.78	0.125	0.53	0	2.20	0
f. Unwilling sellers	No. of property owners		Time constraints associated with the conduct of this study prevented the development of a statistically reliable survey instrument and sample survey. As a result, a specific estimate of the numbers of unwilling sellers has not been developed.										

3. Analyze Cost Effectiveness

Measure	Units	Base 95	Alt 1	Alt 2B	Alt 3	Alt 4	Alt 5	Alt 6B	Alt 6C	Alt 6D	Alt 7	Alt 8A	Alt 9
a. Project costs	O&M and Replacement Costs ($M/yr)		.27	.33	0	0	0	.33	.33	.40	.43	.35	.37
	Real Estate Costs ($M)		4.1	4.1	110.2	122.8	164.8	115.0	30.7	55.7	110.5	127.0	4.1
	Capital Costs ($M)		26.5	29.8	125.6	9.2	14.2	32.7	32.1	32.4	24.1	26.8	35.8
	Total Initial Project Costs ($M)		30.6	33.9	235.8	132.0	179.0	147.7	62.8	88.1	134.6	153.7	39.9
b. Local Costs	Capital Cost ($M)		0	0	0	0	0	36	0	0	0	0	0
	Annual O&M Costs ($M)		0	0	0	0	0	0.90	0	0	0	0	0

1) Capital cost includes all design and construction management costs and contingency; it does not include real estate costs.
2) O & M and Replacement costs are presented as annual costs.
3) O&M costs do not include ecological O&M or water quality monitoring.
4) Real estate costs include all fee simple acquisition and flowage easements.

Table 9 - Continued
Base 95 Comparison

This table presents the comparison of all alternatives to Base 95 (existing) conditions for each performance measure.

4. Analyze Effects to Ecological Functions													
Measure	**Units**	**Base 95**	**Alt 1**	**Alt 2B**	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6B**	**Alt 6C**	**Alt 6D**	**Alt 7**	**Alt 8A**	**Alt 9**
a. Total Wetlands	Area (ac)		7,196	7,583	5,556	7,943	7,943	7,114	6,688	7,464	7,943	6,473	7,391
b. Short-Hydroperiod Marl Forming Wetlands	Area (ac)		-4,663	-5,104	-5,283	-3,954	-3,954	-4,279	-5,063	-4,298	-3,954	-4,445	-4,883
c. Long-Hydroperiod Peat Forming wetlands	Area (ac)		11859	12687	10839	11897	11897	11393	11751	11762	11897	10918	12274
d. WRAP Score	Functional Units		-2,765	-2,765	-1,775	2,448	2,448	1,606	-1,805	1,322	1,290	2,240	-2,765

5. Evaluate Effects on Conditions Favorable to Federal and State Listed Endangered Species Survival													
Measure	**Units**	**Base 95**	**Alt 1**	**Alt 2B**	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6B**	**Alt 6C**	**Alt 6D**	**Alt 7**	**Alt 8A**	**Alt 9**
a. Cape Sable Seaside Sparrow		A Biological Assessment (BA) under the provisions of Section 7 of the Endangered Species Act (50 CFR 402), prepared by the USACE, has concluded that the project would not be likely to adversely affect any listed species. Coordination with the USFWS has been initiated and concurrence with this determination requested.											

6. Measure compatibility with CERP and C-111 projects without adversely impacting the current level of flood protection east of L-31N													
Measure	**Units**	**Base 95**	**Alt 1**	**Alt 2B**	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6B**	**Alt 6C**	**Alt 6D**	**Alt 7**	**Alt 8A**	**Alt 9**
a. Compatibility with CERP	Qualitative (R/Y/G)		Better	Better	Better	Better	Better	Better	Better	Better	Better	Better	Better
b. Compatibility with C-111	Qualitative (R/Y/G)		Worse	Better	Same	Same	Same	Better	Better	Better	Same	Better	Better
c. Agricultural lands east of L-31N	Stage (ft)		0.40	0.25	0.35	0.37	0.37	0.26	0.20	0.30	0.37	0.35	0.33

7. Analyze Impacts and Costs Associated With Time Delays in Implementation of Alternatives													
Measure	**Units**	**Base 95**	**Alt 1**	**Alt 2B**	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6B**	**Alt 6C**	**Alt 6D**	**Alt 7**	**Alt 8A**	**Alt 9**
a. Environmental and cultural resources		Not Applicable for this Comparison											
b. Ability to meet implementation schedule													
c. Construction delays													
d. Administrative requirements of alternatives													

Table 10
Comparison to Authorized Plan

This table presents the comparison of all alternatives to the Authorized Plan (Alt. 1) for each performance measure.

1. Evaluate Effects on Hydropatterns in NESRS.

Measure	Units	Base 95	Alt 1	Alt 2B	Alt 3	Alt 4	Alt 5	Alt 6B	Alt 6C	Alt 6D	Alt 7	Alt 8A	Alt 9
a. Hydroperiod Impacts	Increased Hydroperiod (ac)			-314	1,115	1,115	1,115	1,115	643	1,115	1,115	1,115	-157
	Decreased Hydroperiod (ac)			314	-1,114	-1,114	-1,114	-1,114	-643	-1,114	-1,114	-1,114	157
b. Water depths	Increased depth (ac)			218	3,036	2,765	2,765	2,708	1,283	2,708	2,765	2,669	109
	Decreased depth (ac)			-218	-2,707	-2,707	-2,707	-2,707	-1,282	-2,707	-2,707	-2,612	-109
c Effects on Seasonal variability	Minimum stage, (ft)			0.08	0.34	0.22	0.22	0.25	0.36	0.23	0.22	0.30	0.04
	Maximum stage, (ft)			0.02	0.29	0.20	0.20	0.24	0.12	0.20	0.20	0.26	0.01
	Range of stage, (ft)			-0.07	-0.06	-0.07	-0.07	-0.05	-0.05	-0.06	-0.07	-0.08	-0.04
d. Duration of continuous flooding	Consecutive weeks of inundation			3	3	3	3	6	4	6	3	6	2

2. Evaluate Impacts to the Landowners and Residents of the 8.5 SMA Resulting From Implementation of the Modified Water Deliveries Project.

Measure	Units	Base 95	Alt 1	Alt 2B	Alt 3	Alt 4	Alt 5	Alt 6B	Alt 6C	Alt 6D	Alt 7	Alt 8A	Alt 9
a. Flood mitigation damages	Area of damages, (ac, %)			0	4693 73%	N/A	N/A	150 2%	0	546 9%	4404 69%	2013 31%	0
b. Flood protection damages	Area of damages, (ac, %)			N/A	5825 90%	N/A	N/A	150 2%	N/A	N/A	N/A	N/A	N/A
c. Impacts to business	No. of businesses impacted			0 0%	0 0%	4 100%	4 100%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
d. Impacts to Residences	No. of residences impacted			0	0	16	207	128	16	34	0	103	0
	Total no. of structures impacted			0	0	40	513	318	40	86	0	257	0
e. Impacts tp agricultural lands	Lost area (ac)			0 0%	0 0%	0 0%	2,642 100%	1,175 44%	51 2%	215 8%	0 0%	900 34%	0 0%
	Lost annual income ($M/yr)			0	0	0	6.46	2.78	0.125	0.53	0	2.20	0
f. Unwilling sellers	No. of property owners			Time constraints associated with the conduct of this study prevented the development of a statistically reliable survey instrument and sample survey. As a result, a specific estimate of the numbers of unwilling sellers has not been developed.									

3. Analyze Cost Effectiveness

Measure	Units	Base 95	Alt 1	Alt 2B	Alt 3	Alt 4	Alt 5	Alt 6B	Alt 6C	Alt 6D	Alt 7	Alt 8A	Alt 9
a. Project costs	O&M and Replacement Costs ($M/yr)			0.06	-0.27	-0.27	-0.27	0.06	0.06	0.13	0.16	0.08	0.10
	Real Estate Costs ($M)			0.0	106.1	118.7	160.7	110.9	26.6	51.6	106.4	122.9	0.0
	Capital Costs ($M)			3.3	99.1	-17.3	-12.3	6.2	5.6	5.9	-2.4	0.3	9.3
	Total Initial Project Costs ($M)			3.3	205.2	101.4	148.4	117.1	32.2	57.5	104.0	123.1	9.3
b. Local Costs	Capital Cost ($M)			0	0	0	0	36	0	0	0	0	0
	Annual O&M Costs ($M/yr)			0	0	0	0	0.90	0	0	0	0	0

1) Capital cost includes all design and construction management costs and contingency; it does not include real estate costs.
2) O & M and Replacement costs are presented as annual costs.
3) O&M costs do not include ecological O&M or water quality monitoring.
4) Real estate costs include all fee simple acquisition and flowage easements.

Table 10 - Continued
Comparison to Authorized Plan

This table presents the comparison of all alternatives to the Authorized Plan (Alt. 1) for each performance measure.

4. Analyze Effects to Ecological Functions													
Measure	**Units**	**Base 95**	**Alt 1**	**Alt 2B**	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6B**	**Alt 6C**	**Alt 6D**	**Alt 7**	**Alt 8A**	**Alt 9**
a. Total Wetlands	Area (ac)			387	-1,640	747	747	-82	-508	268	747	-723	195
b. Short-Hydroperiod Marl Forming Wetlands	Area (ac)			-441	-620	709	709	384	-400	365	709	218	-220
c. Long-Hydroperiod Peat Forming wetlands	Area (ac)			828	-1,020	38	38	-466	-108	-97	38	-941	415
d. WRAP Score	Functional Units			0	990	5,213	5,213	4,371	960	4,087	4,055	5,005	0
5. Evaluate Effects on Conditions Favorable to Federal and State Listed Endangered Species Survival													
Measure	**Units**	**Base 95**	**Alt 1**	**Alt 2B**	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6B**	**Alt 6C**	**Alt 6D**	**Alt 7**	**Alt 8A**	**Alt 9**
a. Cape Sable Seaside Sparrow		A Biological Assessment (BA) under the provisions of Section 7 of the Endangered Species Act (50 CFR 402), prepared by the USACE, has concluded that the project would not be likely to adversely affect any listed species. Coordination with the USFWS has been initiated and concurrence with this determination requested.											
6. Measure compatibility with CERP and C-111 projects without adversely impacting the current level of flood protection east of L-31N													
Measure	**Units**	**Base 95**	**Alt 1**	**Alt 2B**	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6B**	**Alt 6C**	**Alt 6D**	**Alt 7**	**Alt 8A**	**Alt 9**
a. Compatibility with CERP	Qualitative (R/Y/G)			Same	Same	Same	Same	Same	Same	Same	Same	Same	Same
b. Compatibility with C-111	Qualitative (R/Y/G)			Better	Same	Same	Same	Better	Better	Better	Same	Better	Better
c. Agricultural lands east of L-31N	Stage (ft)			-0.15	-0.05	-0.03	-0.03	-0.14	-0.20	-0.10	-0.03	-0.05	-0.07
7. Analyze Impacts and Costs Associated With Time Delays in Implementation of Alternatives													
Measure	**Units**	**Base 95**	**Alt 1**	**Alt 2B**	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6B**	**Alt 6C**	**Alt 6D**	**Alt 7**	**Alt 8A**	**Alt 9**
a. Environmental and cultural resources	Qualitative (R/Y/G)			See Section 5.2.7 in GRR for discussion of this measure									
b. Ability to meet implementation schedule	Qualitative (R/Y/G)			Same	Worse	Worse	Worse	Worse	Worse	Worse	Worse	Worse	Same
c. Construction delays	Qualitative (R/Y/G)			Same	Worse	N/A	N/A	Same	Same	Same	Same	Worse	Same
d. Administrative requirements of alternatives	Qualitative (R/Y/G)			Same	Worse	Worse	Worse	Worse	Worse	Worse	Worse	Worse	Same

Table 11

Four Week Average Around Minimum Weekly Average Groundwater Head for Selected ENP Indicator Cells						
Plan Description	**ENP Model Indicator Cells[1]**					**Average [ft]**
	19990	**20378**	**20890**	**21271**	**24577**	
Base 95	6.94	5.86	6.45	4.85	3.83	5.59
Alternative 1	8.00	6.82	7.53	6.28	4.43	6.61
Alternative 2B	7.97	6.73	7.55	6.71	4.49	6.69
Alternative 3	8.13	7.75	7.74	6.73	4.41	6.95
Alternatives 4,5 & 7	8.09	7.29	7.68	6.70	4.41	6.83
Alternative 6B	8.06	7.13	7.68	6.95	4.49	6.86
Alternative 6C	8.00	7.92	7.66	6.77	4.50	6.97
Alternative 6D	8.06	7.16	7.67	6.84	4.47	6.84
Alternative 8A	8.08	7.23	7.68	7.10	4.43	6.91
Four Week Average Around Maximum Weekly Average Groundwater Head for Selected ENP Indicator Cells						
Plan Description	**ENP Model Indicator Cells[1]**					**Average [ft]**
	19990	**20378**	**20890**	**21271**	**24577**	
Base 95	8.69	8.22	8.32	7.57	6.64	7.89
Alt No.1	9.15	8.08	8.52	7.74	6.74	8.05
Alternative 2B	9.13	7.83	8.54	8.10	6.76	8.07
Alternative 3	9.35	8.81	8.73	8.07	6.75	8.34
Alts No. 4,5 & 7	9.27	8.54	8.67	8.03	6.75	8.25
Alternative 6B	9.26	8.33	8.70	8.40	6.77	8.29
Alternative 6C	9.18	7.92	8.63	8.36	6.77	8.17
Alternative 6D	9.24	8.33	8.67	8.24	6.76	8.25
Alt No .8A	9.28	8.52	8.68	8.33	6.75	8.31

Notes: 1. Indicates cell numbers in layer 3 of MODBRANCH model grid

Table 12
Average Range of Indicator Cells for ENP Expansion Lands

Category	Cell	Alternatives								
		Base 95	Alt 1	Alt 2B	Alt 3	Alts 4,5,7	Alt 6B	Alt 6C	Alt 6D	Alt 8A
ENP Indicator Cells	21271	3.38	2.01	1.85	1.83	1.83	2.00	2.06	1.98	1.79
	21791	3.62	1.95	1.73	1.74	1.75	1.79	1.84	1.78	1.72
	20890	2.08	1.60	1.60	1.60	1.60	1.62	1.62	1.60	1.61
	19990	1.93	1.59	1.60	1.66	1.62	1.64	1.62	1.62	1.64
	20378	2.87	2.07	1.88	1.70	1.65	1.61	1.57	1.58	1.70
	24577	3.34	2.96	2.87	2.94	2.95	2.88	2.87	2.89	2.92
	24587	2.91	2.63	2.53	2.65	2.63	2.59	2.61	2.63	2.59
	19177	1.33	1.91	1.92	1.95	1.93	1.95	1.93	1.94	1.94
	19213	1.40	1.50	1.59	1.61	1.58	1.61	1.60	1.59	1.59
AVG		2.54	2.02	1.95	1.96	1.95	1.97	1.97	1.96	1.94

Table 13
Continuous Flooding Duration of Indicator Cells for ENP Expansion Lands

Category	Cell	Alternatives								
		Base 95	Alt 1	Alt 2B	Alt 3	Alts 4,5,7	Alt 6B	Alt 6C	Alt 6D	Alt 8A
ENP Indicator Cells	21271	27	28	31	31	31	34	32	32	34
	21791	30	31	52	34	34	52	52	52	52
	20890	52	52	52	52	52	52	52	52	52
	19990	52	52	52	52	52	52	52	52	52
	20378	31	31	31	52	52	52	32	52	52
	24577	30	27	31	31	31	31	32	32	31
	24587	25	26	28	26	26	28	29	28	26
	19177	52	52	52	52	52	52	52	52	52
	19213	52	52	52	52	52	52	52	52	52
AVG		39	39	42	42	42	45	43	45	45

Table 14
Average Stage of Indicator Cells for Agricultural Lands

Category	Cell	Alternatives								
		Base 95	Alt 1	Alt 2B	Alt 3	Alts 4,5,7	Alt 6B	Alt 6C	Alt 6D	Alt 8A
Agriculture Indicator Cells	19761	6.77	7.29	7.09	7.22	7.23	7.13	7.07	7.16	7.21
	19766	6.13	6.70	6.50	6.63	6.64	6.53	6.47	6.57	6.62
	20031	6.73	7.24	7.04	7.22	7.22	7.11	7.02	7.14	7.20
	20036	6.08	6.57	6.39	6.52	6.53	6.43	6.35	6.46	6.51
	20390	6.84	7.25	7.04	7.17	7.23	7.09	6.95	7.13	7.20
	20396	5.51	5.64	5.60	5.61	5.64	5.59	5.55	5.61	5.63
	20931	6.50	6.89	6.74	6.82	6.87	6.68	6.68	6.73	6.84
	20936	5.99	6.20	6.14	6.17	6.20	6.10	6.09	6.13	6.18
AVG		6.32	6.72	6.57	6.67	6.69	6.58	6.52	6.62	6.67

Table 15
Summary of Changes to Authorized Plan

Feature	Alternative 1	Recommended Plan
Area provided flood mitigation (% of 8.5 SMA)	100%	55%
Cost Estimates (MCACES) Capital Real Estate Total	 $34,359,800 $10,046,400 $44,406,200	 $32,615,900 $73,925,330 $106,541,230
Total Annual Costs	$ 2,765,794	$ 7,275,299
Funding Capital O&M Post-Construction Maintenance	 100% Federal 75% Federal/25% Local N/A	 100% Federal 75% Federal/25% Local 100% Local
Exterior Levee:		
Location	Along north and west perimeter of 8.5 SMA	Inside of north and west perimeter of 8.5 SMA a distance of 0.10 to 1.05 miles.
Adjacent Canal	Yes	No
Borrow Material	From adjacent canal construction	Hauled from canal construction
Estimated length (ft)	40,200	34,600
Top Width (ft)	58	58
Top Elevation	+10.2	+10.2
Side Slopes (H:V)	4:1	4:1
Fill Volume (cy)	404,500	347,800
Seepage Canal		
Location	Adjacent to exterior levee	East or south of exterior levee a distance of 500 to 5,500 ft.
Estimated length (ft)	40,200	20,800
Bottom Width (ft)	15 to 40	25 to 30
Invert Elevation:	-1.5 to –8.5	-6 to –8.5
Hydraulic Capacity (cfs)	500	500
Access Requirements	No	Yes, 3 bridges included
Interior Berm(s)		
Location	Immediately east/south of exterior levee and seepage canal	Berms constructed on both sides of seepage canal.
Adjacent Canal	Yes	Yes
Borrow Material	From adjacent canal	From adjacent canal
Estimated length (ft)	40,200	20,800
Top Width (ft)	10	10
Top Elevation:	+9.5	+9.5
Side Slopes (H:V)	3:1	3:1
Fill Volume (cy)	107,500	110,800
Pump Station		
Location	NE Corner of 8.5 SMA at the L-31N Canal	Southern terminus of seepage canal
Discharge to	L-31N	C-111 via discharge pipe and treatment area
Hydraulic Capacity (cfs)	500	500
No. of pumps	3	3
Real Estate Acquisition (ac)	663	2335
Flowage Easements (ac)	0	546

Table 16
Canal Dimensions to Handle Seepage
Recommended Plan

Corps Calculated Flow Rate =	500 cfs	Delta H	0.5 ft
Total Length =	20,773 ft	Slope =	2E-05 ft/ft
Flow Rater per LF =	0.02406971 cls/lf	El. G.S =	6.5 ft/ft

				Canal Dimensions			
Segment - North to South	**Segment Length**	**Cumulative Length at End of Segment**	**q at End of Segment (cfs)**	**Width (ft)**	**Depth (ft)**	**Elevation (ft)**	**Cumulative Volume cy**
A1-E1	9098	9098	219	25	12.5	-6	157951
E1-I1	11675	20773	500	30	15	-8.5	449826
						Subtotal	449826
						Total Excavation with 20% Overcut	539792